THE AUSTRALIAN REINFORCED CONCRETE ENGINEERING CO. PTY. LTD.

B. R. C. REINFORCEMENTS

W. J. DREWE

RJA

1979

APPLICATIONS OF THE

B.R.C.

System of Reinforced Concrete Construction

ERRATA

PAGE 3.—" Agencies," last line: read " and Perth."

PAGE 28, TABLE 1.—Reference No. of Fabric 10—7th column. Sectional area of each longitudinal wire (sq. ins.) .0280 should read .0290.

PAGE 29, TABLE 1.—4th column, length of standard sheet 17 ft., should read 17 ft. 4 in.

PAGE 60, TABLE 11 (Eleven).—Floor Slab block should be inverted.

PAGE 144.—Architect: W. M. Shields, Esq., should read: Messrs. Beaver and Purnell.

The Australian Reinforced Concrete Engineering Company Pty. Limited

Head Office:

Normanby Chambers, Chancery Lane, Melbourne

Works:

Sunshine, Victoria

Agencies:

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B.R.C.
Reinforcements

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ENLARGED

INTRODUCTION

THIS HANDBOOK has been compiled to bring to your notice the advantages to be derived from the use of B.R.C. Reinforcements.

We have established a Factory at Melbourne, Australia, for the Manufacture and Fabrication of our Reinforcements from Australian Steel.

We have included tables and data generally which are of use to Engineers, Architects, Contractors, and all interested in Reinforced Concrete construction.

All enquiries will receive prompt attention.

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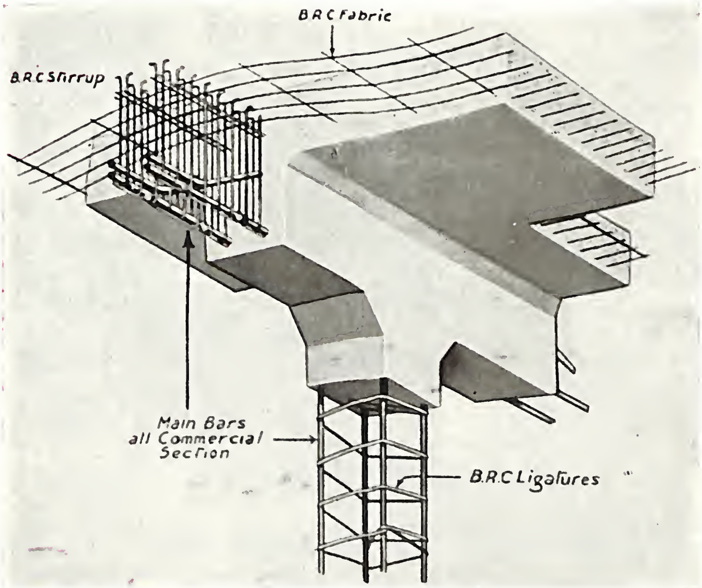
B.R.C. Systems of Reinforced Concrete Construction.

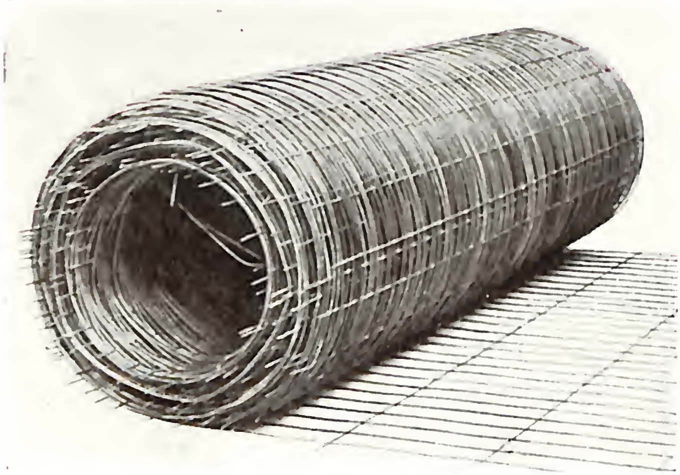
Typical Details for Columns, Beams, Floors



GENERAL CONSTRUCTION.

The B.R.C. Systems cover the whole range of Reinforced Concrete Construction in the simplest and most complete manner. The special features of the systems provide a margin of safety much in excess of the figure allowed for in ordinary calculations

B.R.C. Fabric for Floors, Roads, Slabs, &c.



EASE OF HANDLING.

B.R.C. Fabric is the easiest of all reinforcements to handle or cut to shape. Contractors find that it costs several pence less to handle per square yard than its equivalent in small steel rods.

SAFETY AND SIMPLICITY

The outstanding features in the use of B.R.C. Fabric are the ease and accuracy with which it can be placed in position, and the absence of risk of omission or displacement.

The Australian Reinforced Concrete Engineering Co. Pty. Ltd.

ENGINEERING DEPARTMENT.

The services of our Engineering Department are at the disposal of our clients.

We employ a staff of engineers of proved ability and experience, and are ready to prepare and submit schemes and designs for all classes of reinforced concrete work.

ARCHITECTURAL WORK.

We do not carry out any Architectural work except under instruction from practising Architects.

RESPONSIBILITY.

We take full responsibility for reinforcements supplied by us in all cases where we have prepared the design for the work in which the reinforcements are used.

Where we do not prepare the design, we take full responsibility for our reinforcement if the design is submitted to us for inspection and detailed checking and receives our approval.

We allow floors designed by us to be tested with 50 per cent. overload, and for beams of average depth the deflection will not then exceed one six-hundredth part of the span.

Description
and
Details of
B.R.C. Fabric

BRC Fabric

GENERAL DESCRIPTION

Material and Manufacture.

B.R.C. Electrically Cross-Welded Steel Wire Fabric is the ideal reinforcement for concrete slabs and surfaces. It consists, Fig. 1, of a Wire Mesh made up of a series of parallel longitudinal wires, held at fixed distances apart by means of transverse wires arranged at right angles to the longitudinal ones, being securely welded to them at the points of contact by a patented electrical process.

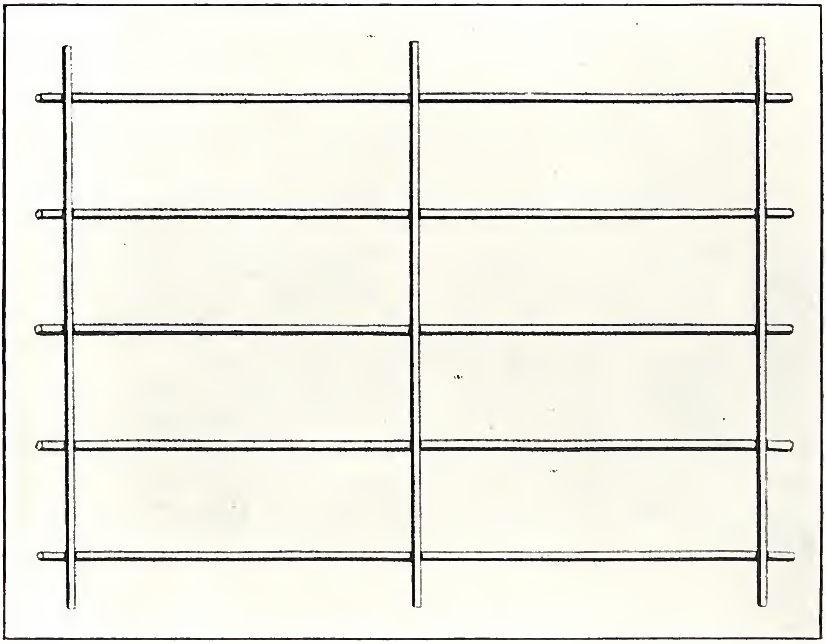


Fig. 1.

The wire used is best quality mild steel.

The longitudinal wires, which may be of any gauge, are automatically drawn from supply reels through a machine, which accurately spaces them at fixed distances apart. The progress of the longitudinal wires through

the machines stops momentarily at definite intervals, whilst a single strand of transverse wire is placed across the longitudinal ones at right angles to their length. At each point where the transverse wire crosses the longitudinals, there is then formed an electrical contact which thoroughly fuses the metal of the two wires together.

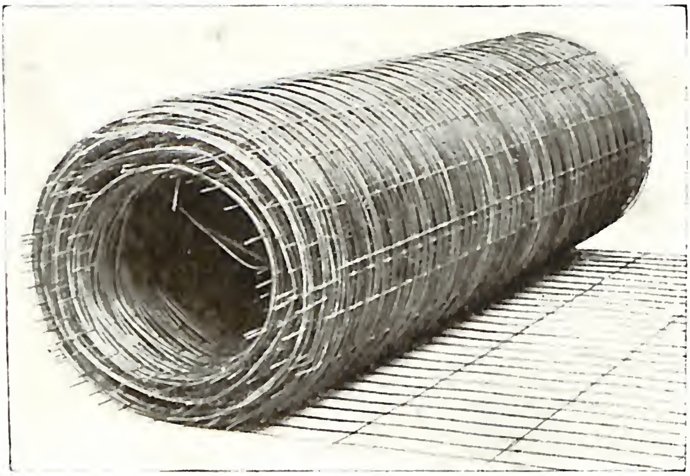


Fig. 2.

The appearance of the finished product is illustrated in the accompanying photograph, Fig. 2, of a roll of B.R.C. Fabric. In this view the unrolled portion of the fabric clearly shows the perfect alignment of the wires, and the efficient manner in which they are held in their proper relative positions.

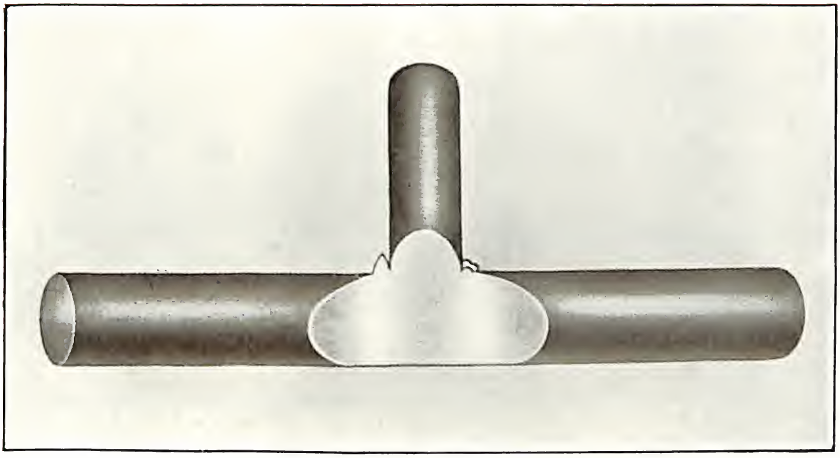


FIG. 3.

Nature of Weld.

Fig. 3 is a view of a piece of Electrically Cross-Welded Steel Wire illustrating the character of the weld between the longitudinal and transverse wires; the two wires have been cut through at their point of union, revealing a perfectly smooth surface, in which it is impossible to detect the slightest evidence of separation between the wires. Even when seen through a microscope this surface shows absolutely smooth and unbroken.

In view of the fact that the transverse wires are not secured to the longitudinal ones by means of wire loops or clips, the casual observer is led to the conclusion that the wires are merely soldered together, or connected in some frail manner. Such a conclusion is completely erroneous. The connection is made by an absolute and perfect weld, the two wires having been fused, and become actually homogeneous through the application of an electric current.

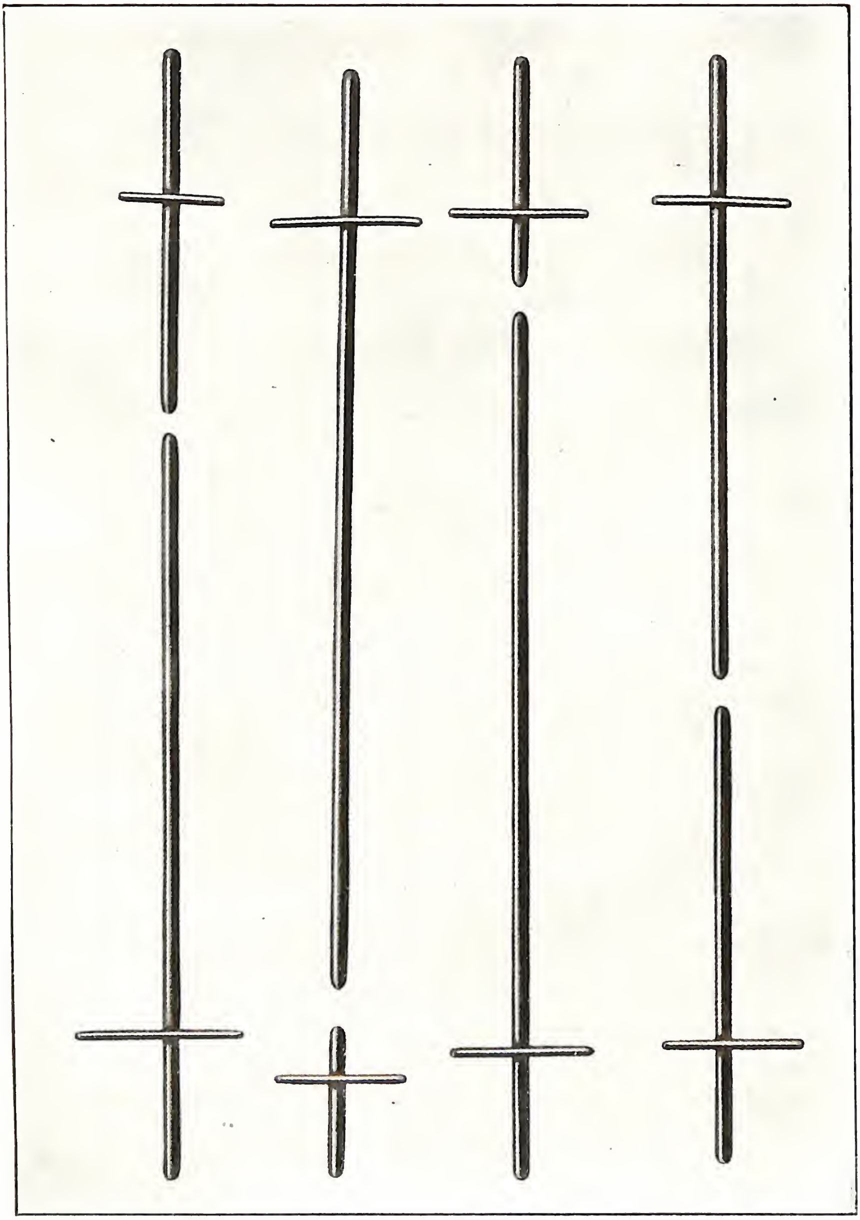


Fig. 4.

Fig. 4 shows strands of B.R.C. Electrically Cross-Welded Steel Wire that have been subjected to tension until broken. It may be seen that in each instance the failure occurs other than at the weld. Hundreds of such tests have been made, and never in a single instance has a wire broken directly at the weld.

There is no doubt that the strength of the wire at the points of welding is greater than elsewhere.

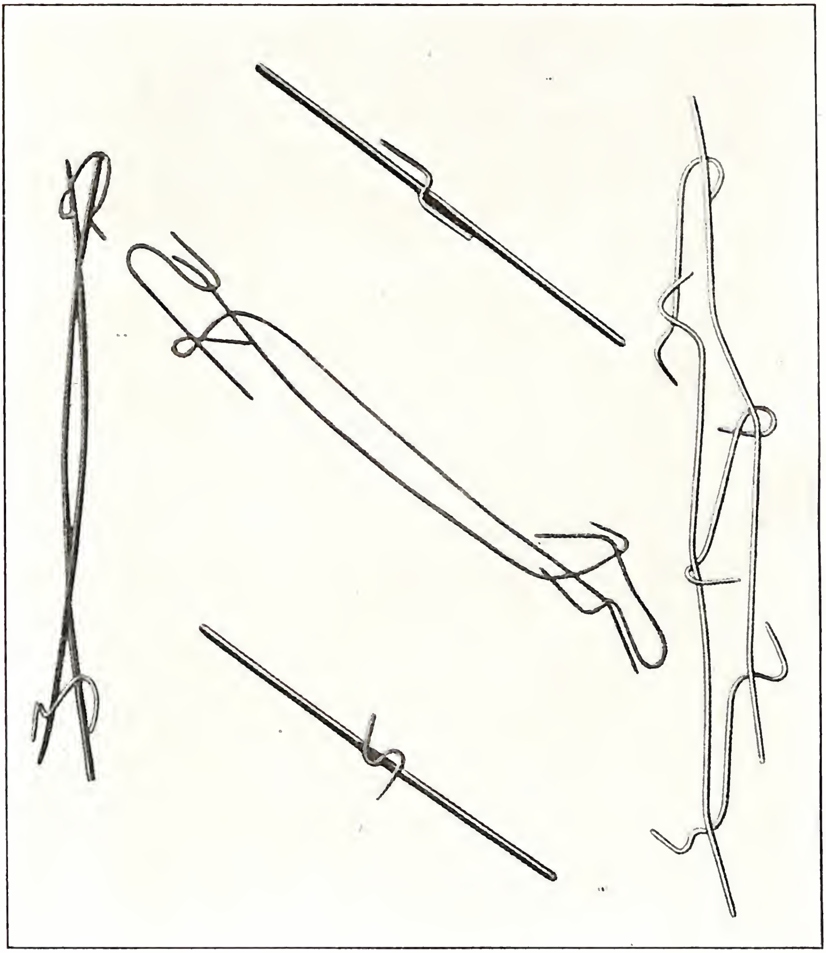


Fig. 5.

Many other tests (Fig. 5) in which samples of the Fabric have been subjected to the worst possible conditions of bending and twisting, completely distorting them, have been made, and in no case has the material broken at one of the welds.

Exhaustive laboratory experiments have demonstrated that the texture of the steel at the weld, as revealed by microscopic examination, has undergone a certain purification through the electric fusion of the metal. All tests and experiments have shown that the union of the transverse and longitudinal wires is absolute at all points of contact.

Spacing of Wires.

Every strand of wire entering into the construction of B.R.C. Fabric is, through its process of manufacture, properly placed with mechanical accuracy. In this way is accomplished by machinery that essential element of construction, which in other types of reinforcing material is left in the hands of unskilled workmen after it has reached its destination.

B.R.C. Fabric is not shipped in a thousand and one separate parts, but in compact rolls, ready for installation as a perfect reinforcement made of the best grade of drawn steel wire, formed into a mesh.

The purchaser obtains a reinforcement wherein all the work has been accomplished at the factory by skilled mechanics and perfected machinery. It reaches its destination in such a form that it may be easily, rapidly, and economically laid.

ADVANTAGES IN USE

Strength of Steel Wire

Every inch of wire that is introduced into the construction of our Cross-Welded Fabric is rendered through its very process of manufacture a material of tested and determined strength. Close fibred steel, drawn under considerable strain, is much stronger and more durable than either rolled steel bars or stamped sheets, which undoubtedly suffer much injury through cold cutting and distortion.

In this respect B.R.C. Cross-Welded Fabric possesses an element of strength which cannot be claimed for the ordinary type of reinforcement. To further ensure reliability, every coil of wire is tested at our works, and is not utilised in our manufactures unless its tensile strength is equal to that on which our Tables are based.

Rigidity

Modern practice, backed by the tests and experiments of recognised authorities, has demonstrated the immense importance of rigidity in all types of reinforcement. B.R.C. Cross-Welded Fabric provides the greatest possible rigidity, owing to its having an absolute physical connection at each point of intersection, thus overcoming the great defect of all other systems of rod or wire mesh reinforcement. In these other systems such absolute connection is non-existent.

Continuity of Reinforcement

B.R.C. Cross-Welded Fabric is laid in sheets up to seven feet in width, and of any length. There is thus obtained a complete sheet of reinforcing material extending from end to end of the structure, and giving throughout its entire length a perfectly unbroken reinforcement of drawn steel wire, providing one single continuous beam, far stronger than the large number of separate units usually employed.

The transverse wires take up the transverse temperature stresses and distribute the "accidental" loads evenly over the longitudinal reinforcement.

Direct Action in Reinforcement

It is a well-established principle that any structure in sustaining certain loads is deformed by those loads in such a way that the total work done by the resisting stresses in the material is a minimum. The most efficient type of reinforcing material is the one capable

of resisting all tensile stresses in the simplest and most direct manner. Both theoretical and practical demonstrations show the fallacy of statements to the effect that a zigzag, crimped, or indirect line of reinforcement, when embedded in the concrete, is as efficient as a direct line. It has been amply demonstrated that any irregularly shaped mesh introduced into concrete, and placed close to the bottom of the slab, has a tendency to yield and shear or flake off the concrete on the underside, and to close up on deflection of the slab. B.R.C. Cross-Welded Fabric reinforces efficiently on direct lines of tension, and maintains its original form when stressed.

Ease and Accuracy of Installation.

The most important, and in many cases the most difficult, work in connection with the erection of reinforced concrete structures is the accurate placing of the steel. In order that a slab of concrete may safely sustain its superimposed load, it is not merely essential that it be provided with a certain amount of steel, but the steel, in order to do its duty, must be definitely located in the concrete.

Carelessness in regard to this important feature has led to several failures in structures of reinforced concrete. The greatest care should always be exercised in placing reinforcement.

Where single rods are used, or short sheets of reinforcement, a considerable expenditure of time and money is involved, as it is necessary to lay the pieces separately, to carefully space them, and then to fasten them in position. The correctness or otherwise of such positions is completely dependent on the man who is actually laying the reinforcement. This risk is eliminated by using B.R.C. Cross-Welded Fabric. It comes to the work in rolls, and can be neatly stored in a small space until required, and when required can be easily laid. The exact spacing of the wires is already established, and it is impossible for their relative positions to become changed in the slightest degree either before or after laying.

Employers' Liability.

The use of B.R.C. Cross-Welded Fabric reduces to a minimum the risk under the Employers' Liability Act. There is less danger to life and property where our Fabric is used, with its complete unbroken sheet of reinforcement, than where innumerable bars and rods or sheets of reinforcing material in short lengths are employed.

Flexibility of Design B.R.C. Cross-Welded Fabric is not, like many other forms of reinforcement, an intricate system that admits of only a restricted usage. It may be adapted to any type of construction, and in all cases provides a simple and efficient means of continuous reinforcement. It is commonly used in the construction of Foundations, Walls, Partitions, Slabs, Floors, Roofs, Bins, Tanks, Reservoirs, Sewers, Culverts, Bridges, Retaining Walls, Platforms, Pavements, Fireproofing of Steelwork, and flat or curved Concrete Surfaces of all kinds.

On page 52 we give diagrams showing the application of our Fabric to Floors, whether carried on steel beams, or reinforced concrete beams. We also append Tables showing the safe loads for different thicknesses of floor, reinforced with various sizes of Fabric.

Guarantee Against Movement of the Welded Wire Each point of intersection between longitudinal and transverse wires must develop at least one half the full strength of the transverse wire before the bond securing the longitudinal and transverse wires shows any movement.

This result cannot be obtained by means of secondary fasteners, clips, or crimping.

SIZES OF B.R.C. ELECTRICALLY CROSS-WELDED STEEL WIRE FABRIC

The following particulars apply to our Standard Manufactures. We can, however, supply almost any combination of wire to meet customers' requirements.

Type of Wire

The wire used is best quality mild steel. The tensile strength varies from 80,000 to 100,000 lbs. per square inch. The elastic limit averages 65,000 lbs. per square inch, and the safe working tensile strength may be taken at 25,000 lbs. per square inch.

Size of Wire

We can furnish any size longitudinal wire from 4/0 to 12 (inclusive) combined with any size transverse wire from 3 to 12 (inclusive) Imperial Standard Wire Gauge, provided the difference between them does not exceed seven numbers of Imperial Standard Wire Gauge; but No. 4 is the heaviest that can be used when both wires are the same size.

Spacing of Longitudinal Wires

Longitudinal wires may be spaced on centres of 2 inches and upwards in steps of ½ inch. Our standard spacings are 3 inches, 6 inches, and 12 inches.

Spacing of Transverse Wires

Transverse wires may be spaced on centres of 1 inch and upwards, in steps of 1 inch. Our standard spacings are 6 inches. 12 inches, 16 inches, and 18 inches.

WIDTHS.

The standard width of Fabric for Ref. Nos. 1 to 14 and 636 is 84 inches, consisting of 28 longitudinal wires spaced at 3 inches centres, with transverse wires projecting $1\frac{1}{2}$ inches beyond each outside wire.; for Ref. No. 655 84 inches, consisting of 14 long wires at 6 inch centres, with transverse wires projecting 3 inches beyond each outside wire; and for Ref. Nos. 610 and 1210 is 87 inches, consisting respectively of 15 longitudinal wires spaced at 6 inches centres and 8 longitudinal wires spaced at 12 inches centres, with transverse wires in each case projecting $1\frac{1}{2}$ inches beyond each outside wire. Ref. No. 98 consists of 10 longitudinal wires spaced at 9 inch centres, with transverse wires projecting $1\frac{1}{2}$ inches beyond each outside wire. The width for which we charge is the distance from tip to tip of transverse wires.

LENGTHS.

B.R.C. Fabric is supplied in rolls or sheets.

Ref. Nos. 1 to 5 are in sheets 17 feet long.

Ref. Nos. 6 to 8 are in rolls 180 feet long.

Ref. Nos. 9 to 1210 are in rolls 240 feet long.

Ref. No. 98 is in rolls 240 feet long.

Ref. Nos. 655 and 636 are in rolls 180 feet long.

Ref. Nos. 6 to 1210 are also supplied in rolls 30 feet long.

STANDARD SIZES.

The following tables give particulars of sizes, weights, strengths, and shipping dimensions of our standard Fabrics which can always be supplied at short notice. Standard sizes are the cheapest to buy and most quickly obtainable.

Fabric Tables

TABLE 1.

B.R.C. FABRIC

PROPERTIES OF STANDARD SIZES

Reference No. of Fabric	Size of Sheet or Roll	SIZE OF MESH AND OF WIRE. Distance centre to centre of Longitudinal Wires (ins.)	Distance centre to centre of Transverse Wires (ins.)	Gauge of Wire: Longitudinal (Imperial Standard)	Gauge of Wire: Transverse (Imperial Standard)	Sectional Area of each longitudinal wire (sq. ins.)	TENSILE STRENGTH. Breaking Strength of each longitud. wire (at 80,000 lbs. per sq. in.) (lbs.)	Safe Tensile Strength (at 25,000 lbs. per sq. in.) in lbs. per ft. width of fabric	Weight per Square Yard
1	17′ 4″	3	16	4/0	4	.1257	10052	12600	16.34
2	,,	,,	,,	3/0	4	.1087	8694	10900	14.26
3	,,	,,	,,	2/0	6	.0951	7608	9500	12.29
4	,,	,,	,,	1/0	6	.0824	6595	8200	10.75
5	,,	,,	,,	1	6	.0707	5655	7100	9.31
6	180′	3	16	2	6	.0598	4785	6000	7.98
7	,,	,,	,,	3	6	.0499	3990	5000	6.77
8	,,	,,	12	4	8	.0423	3381	4200	5.79
9	240′	,,	,,	5	8	.0353	2824	3500	4.93
10	,,	,,	,,	6	8	.0280	2316	2900	4.15
11	240′	3	12	7	8	.0243	1946	2400	3.59
12	,,	,,	,,	8	10	.0201	1608	2000	2.85
13	,,	,,	,,	9	10	.0163	1303	1600	2.39
14	,,	,,	,,	10	10	.0128	1030	1300	1.97
610	,,	6	6	10	10	.0128	1030	650	1.57
1210	,,	12	12	10	10	.0128	1030	325	.78
655	180′	6	6	5	5	.0353	2824	1750	4.32
636	,,	3	10	6	6	.0280	2316	2900	4.59
98	240	9	10	8	8	.0201	1608	2000	1.62

TABLE 1.

B.R.C. FABRIC

PROPERTIES OF STANDARD SIZES

Reference No. of Fabric	SIZES AND WEIGHTS OF ROLLS AND SHEETS					SHIPPING DIMENSIONS.			
	Width of Standard Roll or Sheet (ins.)	Length of Standard Roll (feet)	Length of Standard Sheet (feet)	Contents of Standard Roll or 5 Sheets (square yards)	Weight of Standard Roll or 5 Sheets (lbs.)	Contents of Bundle	Approx. Dimensions of Bundle: Length (ins.)	Dia. or Width (ins.)	Thickness (ins.)
1	84	Made	17	66 1/9	1075	5 Sheets	206	86	3½
2	,,	in	,,	,,	935	,,	,,	,,	3⅜
3	,,	Sheets	,,	,,	810	,,	,,	,,	3⅛
4	,,	only	,,	,,	705	,,	,,	,,	2¾
5	,,		,,	,,	615	,,	,,	,,	2½
6	84	180		140	1118	1 Roll	89	31	
7	,,	,,		,,	948	,,	,,	28	
8	,,	,,		,,	811	,,	,,	27	
9	,,	240		186⅔	921	,,	,,	27	
10	,,	,,		,,	774	,,	,,	25½	
11	84	240	Stocked	186⅔	670	1 Roll	89	24½	
12	,,	,,	in Rolls	,,	532	,,	,,	24	
13	,,	,,	only	,,	446	,,	,,	22½	
14	,,	,,		,,	368	,,	,,	21½	
610	87	,,		193⅓	309	,,	90	26	
1210	,,	,,		,,	160	,,	,,	20	
655	84	180		140	605	,,	,,	32	
636	,,	,,		,,	619	,,	,,	23	
98	84	240		186⅔	302	,,	89	25	

Details of B.R.C. Hoops, Helical Wrappings, and Stirrups

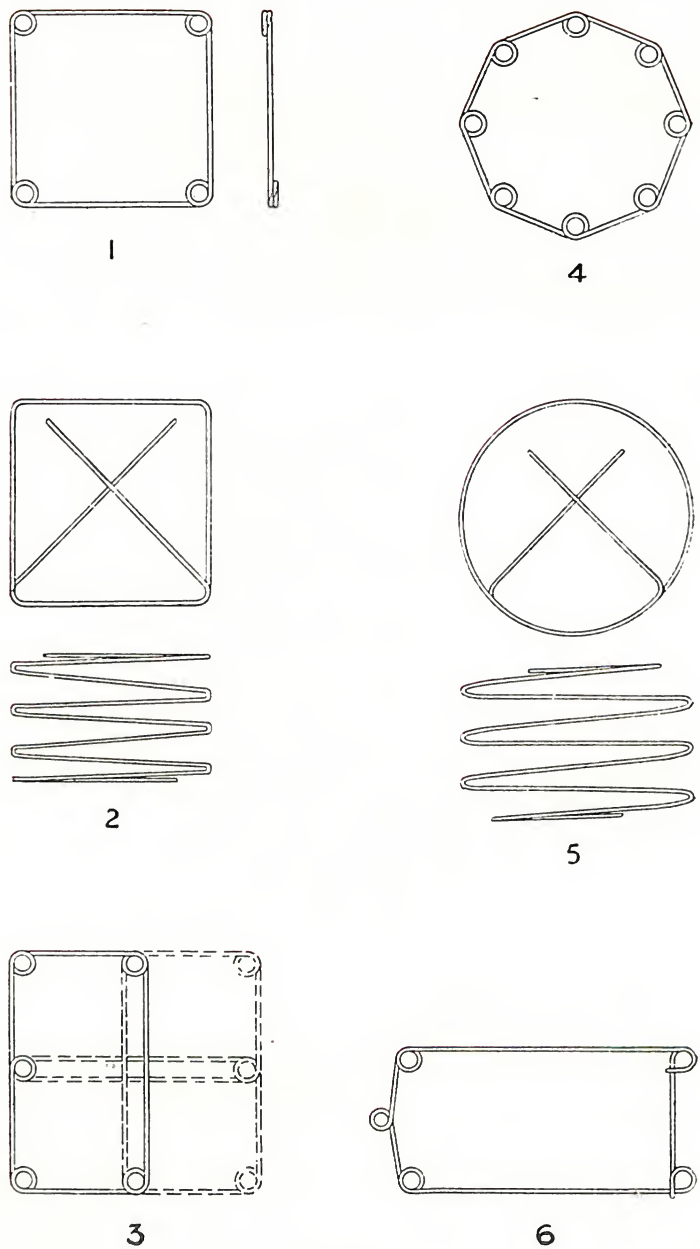


FIG. 6.

B.R.C. HOOPS, HELICAL WRAPPINGS AND STIRRUPS

The following is a detailed description of the ordinary types of B.R.C. Hoops, Helical Wrappings, and Stirrups.

Fig. 6 illustrates details of B.R.C. Hoops and Helical Wrappings.

HOOPS—Fig. 6—Nos. 1, 3, 4, 6

No. 1 is plan and side view of Hoop for use in solid square columns, pillars, piles, and the like. This shape is designed to hoop four bars, a loop or fitment being formed at each corner by coiling the metal. The loops encircle the bars and hold them in their correct position, ensuring that the core be of proper shape and size. A similar type of hoop is used for rectangular columns with sides of unequal length.

No. 3 is rectangular, with one side about twice the length of the other, and is designed to loop five bars, three on one long side and two on the other. It is used for large square columns reinforced with eight bars, and a pair of such loops are placed together, the second one as shown dotted. The next pair would be placed with the sides which cross the core of the column at right angles to those crossing the core in the one shown.

No. 4 is octagonal, and is used for octagonal columns or circular columns reinforced with eight bars. A similar type is used for polygonal or circular columns having other than eight bars, but such are seldom used.

Hoops may be made for any special shape or arrangement of bars.

No. 6 shows a special type to hoop five bars. The loops are set back on one side and set forward on the other, to allow for encircling the rods used in a section, such as a sheet pile, having a projection or tongue on one side and groove on the other.

HELICAL WRAPPINGS—Fig. 6—Nos. 2 and 5

No. 2 is plan and elevation of Helical Wrapping for use in solid square columns, pillars, piles and the like. It is designed to wrap round four bars, one at each corner, in which case hoops as No. 1 would be used in conjunction with it, or round eight bars, in which case the hoops would be as No. 3, but the helicals would still be square as No. 2 and would wrap round the outside bars. A similar type of helical is used for rectangular columns with sides of unequal length.

No. 5 is a circular Helical used for circular or for octagonal columns in conjunction with hoops as No. 4.

Tapered Helicals are used for reinforcing the points of piles.

Helicals may be made for any special shape or arrangement of bars.

B.R.C. Helical Wrappings are in all cases sectionised. The sectionising can be carried out to any desired extent. Our usual standard is three and a quarter complete turns, but in heavy columns they may be much shorter. (In some very heavy columns we have divided the circumferential wrapping into two parts in each circuit, *i.e.*, each section of wrapping has comprised no more than half a complete turn.) The top end of each wrapping is bent inwards to extend well across the concrete core, and the lower end is similarly dealt with. When the column is complete the sections constitute one long helical wrapping from top to bottom. The pitch of the helical is determined by the load which the column is required to carry.

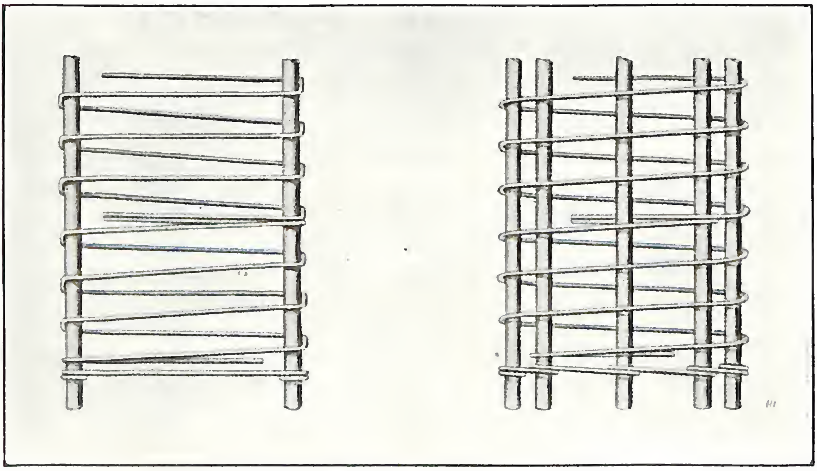


Fig. 7.

Fig. 7 shows the combined use of Hoops and Helical Wrappings. A hoop is generally used after every third wrapping.

The material from which they are made is mild steel of circular section. They fit with mechanical accuracy, but the loops on the hoops are made with a small clearance, so that they may be no difficulty in threading them on to bars that are slightly over gauge. They are despatched to the job ready for use, and there threaded on the bars or rods for which they are intended.

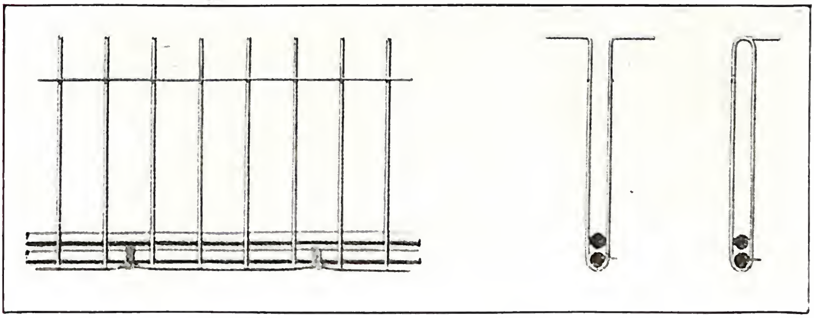


FIG. 8. FIG. 8A. FIG. 8B.

STIRRUPS—Fig. 8

Fig. 8 is a side elevation of our standard Grouped Stirrup. It consists of eight vertical wires spaced at 3-inch centres held together by means of three horizontal wires electrically welded to the vertical wires. By this means the vertical wires are kept at their correct spacing and the group forms a unit which is considerably more stable and more easy to manipulate than any form of single stirrup.

There may be more than three horizontal wires, depending on the height of the stirrup, but there is always one such wire at the bottom and the stirrup is attached by binding this bottom wire to the reinforcing bar with light wire binding as shown.

Stirrups are made from several different sizes of wire to give different strengths, but the vertical wires in any one group are always the same diameter. In the lightest size the vertical wires are spaced 12 inches apart, and this size is generally suitable for the middle portion of the beam where the shearing stress is small.

The tops of the stirrups are generally bent outwards as shown in the end elevation 8A, but in some cases there is no room in the beam for such bent-out ends, and a special type, as shown in 8B, is made to suit this condition.

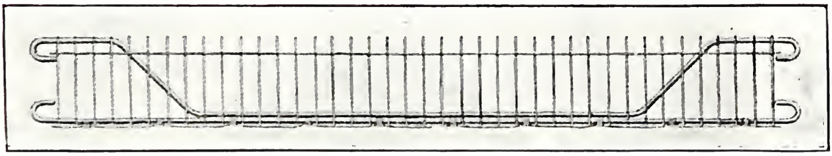


FIG. 9.

The Grouped Stirrup, besides being more easy to manipulate and more rigid than any other, gives a more intimate connection between the reinforcement and the concrete, and a more regular and uniform distribution of stress. It is less liable to be wrongly placed, less liable to displacement, and is a type that we have been able to easily standardise. Where the reinforcement of a beam consists of a double row of bars it is usual to stirrup the bottom row and to bend up the top row towards the supports, as shown in Fig. 9.

If so required the Grouped Stirrup may be used in an inverted position with the ends pointed downwards.

Particulars of standardisation of stirrups are given on pp. 38 and 39, arranged and tabulated in simple form so that users may select and order the sizes suitable for their own designs.

In ordering B.R.C. Grouped Stirrups it is necessary to state

(1) whether type A or type B (see Fig. 8) is required;

(2) the reference number of Fabric from which the Stirrup is made (see Table 3, p. 44);

(3) the height from underside of bar to top of Stirrup; and

(4) the diameter of bar to which the Stirrup is to be applied.

Unless otherwise stated in ordering, it is understood that the term "one stirrup" means one grouped stirrup 2 ft. long.

INDEX OF TABLES

TABLES

The following tables have been prepared for the convenience of users of B.R.C. Reinforcements.

The variety of ways in which steel and concrete may be combined to produce a member (such as a column or beam) of a certain required strength is so large that, before starting the labour of making final calculations, it is often difficult to decide what relative sizes to adopt.

With the object of removing both the initial difficulty of selection and the subsequent labour of calculation, we have compiled lists of the most practical and economical sections of Columns suitable for all ordinary purposes, and prepared tables relating thereto. We have also prepared particulars and special tables for Lintols, Hollow Floors, Wall Foundations, Column Foundations, and Piles, and for Floor Slabs reinforced with B.R.C. Fabric.

The Column Tables show the safe loads that the tabulated sections will carry over various heights when fitted with B.R.C. Reinforcements.

The Slab Tables show the size and weight of B.R.C. Fabric Reinforcement in floor slabs, roof slabs, and the like, necessary to enable the concrete to carry various loads over various spans. A table is given for the most economical combinations of concrete and Fabric, and additional tables for use where the thickness of concrete has been pre-determined. (For full information *re* Slab Table, see notes immediately preceding same.)

In making our calculations we have in all cases used the formulæ recommended in the Report of the Joint Committee on Reinforced Concrete.

The working stresses are as follow:—

	lbs. per square inch
Concrete in compression in beams	600
Concrete in compression in columns	600
Concrete in shear in beams	65
Adhesion of concrete to steel	100
Steel rods and bars in tension	16,000
Steel wire in tension	20,000
Ratio of Co-efficient of Elasticity of steel to that of concrete	15

The tensile strength of the steel wire used in B.R.C. Fabric varies from 80,000 lbs. to 100,000 lbs. per square inch, and the stress at the yield point from 55,000 lbs. to 90,000 lbs. per square inch. The working stress is taken at one-third of the average stress at the yield point. This is safer than using rolled mild steel rods stressed to 16,000 lbs. per square inch. All wire intended for use in our Fabric is regularly tested by us beforehand, to ensure that the standard is maintained.

The Concrete allowed for is composed of broken stone (brick, or gravel), sand, and Portland cement, so proportioned that the voids in the stone and sand are properly filled. This is generally obtained by a 4: 2: 1 mixture, *i.e.*, 4 cubic yards stone, 2 cubic yards sand, and 1 cubic yard (say 22 cwt.) cement, giving about 4 1-3rd cubic yards of concrete. Where the concrete is required to be specially waterproof, and in the case of thin floors, the quantity of cement should be increased to 26 cwt. The stone should in all cases be broken small enough to pass through a $\frac{3}{4}$ inch square mesh. (For fuller information on concrete composition and mixing, see Notes on Concrete, page 104 (*et seq.*).

The reinforcement must not be nearer the surface of the concrete at any point than 2 inch in columns and beams, and $\frac{3}{4}$ inch in floor slabs. This affords proper protection against fire.

COLUMNS

Reinforced Concrete Columns are used in place of columns of steel, iron, or timber; and in place of piers of brick or stone. They are more fire-resisting than columns of other materials, and occupy about the same space as fire-proofed steel columns. They are commonly square in section, but may be made rectangular polygonal, or circular, as required, and corners of square columns may be bevelled.

The face of the columns is left smooth, and in such buildings as works and warehouses does not require plastering. Columns in office buildings may be covered with tile, stone, timber or other material to suit any scheme of decoration. The covering need only be a thin facing.

The concrete is reinforced with vertical rods, encircled at intervals by wire hoops and wrappings. The safe compressive load on the concrete is 600 lbs. per square inch, and on the steel 9,000 lbs. per square inch, the latter in compression being always fifteen times the former, owing to tne relative elasticities of the materials.

The provision of efficient resistance to spreading of the bars and bulging of concrete is absolutely essential to the security of the columns.

Columns may have higher safe loads than the above, depending on the nature and amount of the wrapping. B.R.C. Hoops and Helicals are the most perfect form of binding.

The following table gives the safe loads for various sizes and lengths of columns. The loads must not be used unless the columns are fitted with B.R.C. Hoops and Helicals. The correct form and number of B.R.C. Fittings for each of the tabulated columns are supplied with the column.

The loads are for centrally loaded columns with fixed ends, that is, ends held in such a way as to prevent sideway motion.

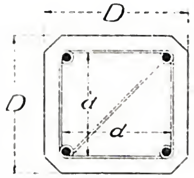
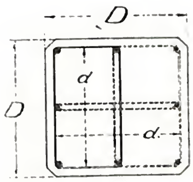
For Columns with one end fixed and the other end free to move sideways, three-quarters of the tabulated loads should be taken.

For Columns with both ends free to move sideways, three-fifths of the tabulated loads should be taken.

In the frequently occurring case of a row of columns supporting a line of beams, the end column has beams connected to it on one side only, therefore the load acts more or less eccentrically and the column is more heavily stressed than it would be by a central load equal in amount. It will generally be correct to design it as a column to carry a safe central load one-third greater than the above-mentioned eccentric load.

TABLE 2

COLUMNS—with ends fixed—centrally loaded. Reinforced with Round Steel Bars and B.R.C. Hoops and Helical Wrappings. (not otherwise applicable.).

Reference No.	Type of Column (Section)	No. of Bars	D (ins.)	d (ins.)	Diam. of Bars	SAFE LOADS—TONS: LENGTH OF COLUMN (FEET) 10	14	18	22	26	30
C41		4	10	7	5/8"	17	16	14	12		
C42					3/4"	19	18	16	14		
C43					7/8"	22	20	18	16		
C44		4	11	8	3/4"	23	22	20	18	16	
C45					7/8"	26	24	22	20	18	
C46					1"	28	26	24	22	20	
C47		4	12	9	3/4"	28	26	24	22	20	
C48					7/8"	30	28	26	24	22	
C49					1"	33	31	29	27	25	
C410		4	13	10	7/8"	35	33	31	29	27	25
C411					1"	38	36	34	32	30	28
C412					1 1/8"	41	39	37	35	33	31
C413		4	14	11	7/8"	41	39	37	35	33	31
C414					1"	44	42	40	38	36	34
C415					1 1/8"	47	45	43	41	39	37
C416		4	15	12	1"	50	48	46	44	42	40
C417					1 1/8"	53	51	49	47	45	43
C418					1 1/4"	57	55	53	51	49	47
C419		4	16	13	1"	57	55	53	51	49	47
C420					1 1/8"	60	58	56	54	52	50
C421					1 1/4"	63	61	59	57	55	53
C422		4	17	14	1"	64	62	60	58	56	54
C423					1 1/8"	67	65	63	61	59	57
C424					1 1/4"	70	68	66	64	62	60
C81		8	14	11	1"	56	54	52	49	46	43
C82			15	12	1"	62	60	57	54	51	48
C83			16	13	1"	69	67	65	62	59	56
C84			17	14	1"	78	78	75	72	69	66
C85			18	15	1"	86	86	83	80	77	74
C86			19	16	1"	95	95	93	90	87	83
C87			20	17	1"	106	106	103	100	97	93
C88			21	18	1"	116	116	116	116	110	104
C89			22	19	1"	127	127	127	127	121	114
C810			23	20	1"	138	138	138	138	132	125
C811			24	21	1"	150	150	150	150	150	150
C812			25	22	1"	161	161	161	161	161	161
C813			26	23	1"	174	174	174	174	174	174
C814			27	24	1"	188	188	188	188	188	188

For columns with one end free take 3/4 of the above loads.
For columns with both ends free take 3-5ths of the above loads.

STIRRUPS

The provision of efficient resistance to shearing stresses is absolutely essential to the security of the beams. The loads given in the tables must not be used unless the bars are fitted with B.R.C. Stirrups to resist shearing stresses.

Shearing stresses are greatest at the supports, and the distribution of shearing stress along a beam depends on the manner in which the load is applied. The maximum shear due to a concentrated central load is only one half the maximum shear due to an equivalent evenly distributed load, but the shear near the centre of the beam due to the former is greater than that due to the latter. It is necessary, therefore, when providing for proper resistance against shear, to consider to a certain extent the manner of application of the load.

In all cases of evenly distributed loads, the shear is zero at the centre of the beam, and increases towards the end of the beam, being there equal to one half the load. The strength of stirrups must be varied accordingly, that is, they must be stronger at the ends than at the middle of the beam.

If a beam is used over a short span it will carry a comparatively heavy load, and the stirrups will require to be heavier. If the same size of beam is used over a long span it will carry a smaller load, and the stirrups will be lighter. In one case the beam is short and the stirrups are heavy; in the other case the beam is long and the stirrups light; in each case the total weight of stirrups is about the same.

STIRRUP TABLES

The standardisation of stirrups as hitherto used, namely, in single pieces of wire or hoop iron, has been a tedious and complicated matter, and rather liable to misunderstanding by users not regularly engaged on this class of work. The introduction of the B.R.C. Grouped Stirrup has made standardisation possible, and so greatly simplified, that it can be used with confidence by anybody dealing with reinforced concrete design.

In the majority of cases in ordinary construction the main tensile reinforcement of the beams, consists of two rows of bars, the bottom row of which requires to be stirruped whilst the top row is bent up towards the supports and provides its own shear resistance. In designing a beam it is first of all necessary to determine the size and number of bars to be used

for tensile reinforcement, by independent calculation, and then, by reference to the accompanying Standard Stirrup Tables, pages 44 and 45, to select the stirrups indicated for the diameter of bar and length of span required and apply such stirrups to each bar in the bottom row, where two rows are used. Where there is one row of bars only the stirrups should be applied to half the number of bars, and should three rows of bars be necessary the stirrups are applied to the bottom row and in addition to half the number in the top row, assuming the middle row and the remaining half of the top row to be bent up towards and continued over the supports.

The stirrup groups are standardised in lengths of two feet each, so that on a bar, say, 14 ft. long there are seven stirrup groups, each one placed close up to the next, therefore no measured spacing is required at the site, whereas in using single stirrups there may be thirty or more required, each of which has to be measured off and spaced at the site and separately attached, obviously a much more costly, tedious, and unreliable process. In beams of uneven length, *i.e.*, not multiples of 2 ft., the middle foot or so may be left blank or the stirrups may be selected for the next lowest even number length, and a middle stirrup be added the same size as the adjacent ones.

B.R.C. Grouped Stirrups are made from B.R.C. Fabric, and the reference numbers in the stirrup table indicate the reference numbers of the Fabrics from which they are made.

For beams carrying uniformly distributed loads, or designed as such (and these comprise the majority of ordinary cases), a greater weight of stirruping is required at the ends than at the centre of the beams; in using single stirrups this is provided for by spacing them closer at the ends than at the centre, and in many cases they are very far apart at the centre, which is not a desirable arrangement, but in using B.R.C. Grouped Stirrups the increased strength towards the supports is provided by using heavier material, the spacing is regular throughout, and there is a much closer general connection between the steel in tension at the bottom of the beam and the concrete in compression at the top.

For beams carrying concentrated loads, such as main beams to which secondary beams are attached, the standard stirrup tables are not applicable, but standard stirrups should be used sufficient to give at any cross section in a length of beam equal to its depth, a tensile strength of stirrup equal to the shear at the section under consideration. The safe working tensile strength per foot run of each standard size of stirrup is given in the following table. The stresses are calculated at 16,000 lbs. per square inch of sectional area of stirrup.

TABLE 3

STRENGTH OF STANDARD B.R.C. GROUPED STIRRUPS

Ref. No. of Stirrups	3	4	5	6	7	8	9	10	11	12	13	14	1210
Area of cross section *per ft. length* (sq. ins.)	.761	.660	.566	.479	.400	.338	.282	.232	.195	.161	.130	.103	.026
Safe Working Tensile Strength of 1 Stirrup *per ft. length* (lbs.)	12200	10600	9100	7700	6400	5400	4500	3700	3100	2600	2100	1650	400

TABLE 4

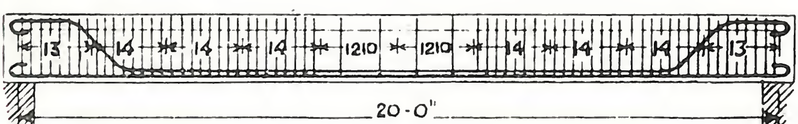
STANDARD STIRRUPS FOR BEAMS WITH ENDS FREELY SUPPORTED

TABLE 4A

Diam. of beam bar (ins.)	Ref. Nos. of Stirrups												
	a	b	c	d	e	f	g	h	j	k	l	m	n
$\frac{5}{8}$	13	14	14	14	14	14	14	14	14	14	1210	1210	1210
$\frac{3}{4}$	11	12	13	13	14	14	14	14	14	14	14	1210	1210
$\frac{7}{8}$	9	10	11	12	12	13	14	14	14	14	14	1210	1210
1	8	9	10	11	11	12	13	13	14	14	14	14	1210
$1\frac{1}{8}$	7	8	9	9	10	11	12	12	13	13	14	14	1210
$1\frac{1}{4}$	5	7	7	8	9	10	10	11	12	13	14	14	1210

TABLE 4B

Length of bar (feet)	Arrangement of stirrups from end to end of bar for any diameter of bar in above table
10	a–d–l–d–a
12	b–e–k–k–e–b
14	c–e–j–l–j–e–c
16	d–f–j–l–l–j–f–d
18	e–f–j–l–m–l–j–f–e
20	f–g–j–l–m–m–l–j–g–f
22	f–h–j–l–l–n–l–l–j–h–f
24	g–h–j–l–l–m–m–l–l–j–h–g
26	h–j–k–l–l–m–n–m–l–l–k–j–h
28	h–j–k–l–l–m–n–n–m–l–l–k–j–h
30	h–j–k–l–l–l–m–n–m–l–l–l–k–j–h



Example.—Stirrups required for $\frac{7}{8}$in. bar in beam 20ft. long.—Note the letters against 20ft. in table 4B, viz., f, g, j, l, m, m, l, j, g, f. The Ref.

Nos. under these letter headings in Table 4A opposite $\frac{7}{8}$in. diam. give the sizes of stirrups to use from end to end of bar in order, viz., 13, 14, 14, 14, 1210, 1210, 14, 14, 14, 13. There are, of course, 10 stirrups, each being a 2ft. length, and they are the same in each direction from the centre outwards.

TABLE 5

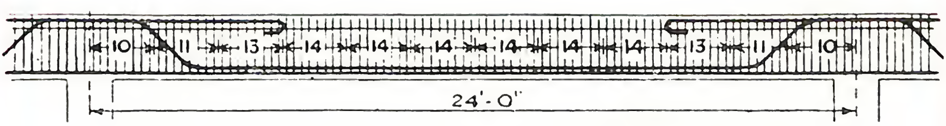
STANDARD STIRRUPS FOR CONTINUOUS BEAMS

TABLE 5A

Diam. of beam bar (ins.)	Ref. Nos. of Stirrups																
	a	b	c	d	e	f	g	h	j	k	l	m	n	p	q	r	s
$\frac{5}{8}$	11	12	13	13	14	14	14	14	14	14	14	14	14	14	1210	1210	1210
$\frac{3}{4}$	9	10	11	11	12	12	12	13	14	14	14	14	14	14	14	1210	1210
$\frac{7}{8}$	7	8	9	10	10	11	11	12	13	13	14	14	14	14	14	1210	1210
1	6	7	8	8	9	9	10	10	11	12	13	13	14	14	14	14	1210
$1\frac{1}{8}$	4	5	6	7	8	8	9	9	10	11	11	12	13	14	14	14	1210
$1\frac{1}{4}$	3	4	4	6	6	7	8	8	9	10	10	11	12	13	14	14	1210

TABLE 5B

Length of bar (feet)	Arrangement of stirrups from end to end of bar for any diameter of bar in above table
10	a–d–n –d–a
12	b–e–l –l –e–b
14	c–e–k –q–k–e–c
16	d–g–k –p–p–k–g–d
18	e–g–k –p–r –p–k–g–e
20	f –h–k –n–q–q–n–k–h–f
22	g–j –k –n–q–r–q–n–k–j –g
24	h–j –l –n–q–r –r –q–n–l –j –h
26	h–k–m–n–p–q–s –q–p–n–m–k –h
28	j –k–m–n–p–q–r –r –q–p–n –m–k –j
30	j –k–m–n–p–q–r –s –r –q–p –n –m–k–j



Example.—Stirrups required for 1in. bar in beam 24ft. long.—Note the letters against 24ft. in table 5B, viz., h, j, l, n, q, r, r, q, n, l, j, h. The ref. Nos. under these letter headings in Table 5A opposite 1in. diam. give the size of stirrups to use from end to end of bar in order, viz., 10, 11, 13, 14, 14, 14, 14, 14, 14, 13, 11, 10. There are, of course, 12 stirrups, each being a 2ft. length, and they are the same in each direction from the centre outwards.

LINTOLS

The most frequent use of Lintols is to carry brickwork over window or door openings.

In some cases, where there are a number of Lintols in the same horizontal line, and the piers supporting them are narrow, the Lintols may be joined together to form a continuous girder; but in the majority of cases, where the ends simply rest on piers, they should be considered as being freely supported.

Our tables are calculated for freely supported ends.

There are various conditions of loading, as illustrated by the following diagrams:—

CONDITION 1

LINTOL IN MIDDLE PORTION OF WALL, OR ONE OF A SERIES OF LINTOLS

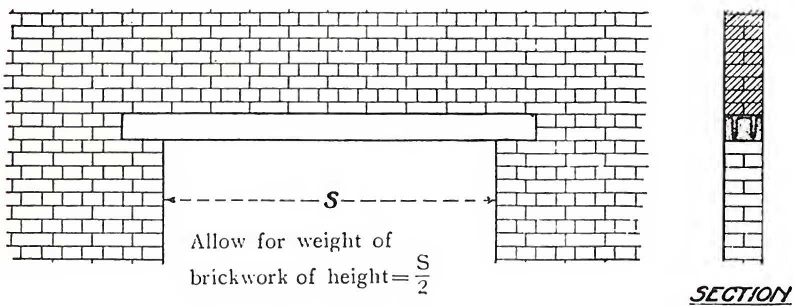


Fig. 10.

In a large number of practical cases the brickwork over an opening arches itself, and only a small load is carried by the lintol. This is the case where a lintol occurs in the middle portion of a wall, or where there is a series of lintols with piers between them. The load on the lintol is then theoretically equivalent to the full weight of brickwork of height equal to one-third of the span.

For practical purposes in such cases, where the actual height of brickwork over the lintol is greater than half the span of the lintol, we recommend that a weight of brickwork of height equal to such half span be allowed for. For weights of brickwork, see Table following Condition 3.

CONDITION 2

ONE END OF LINTOL CLOSE TO END OF WALL

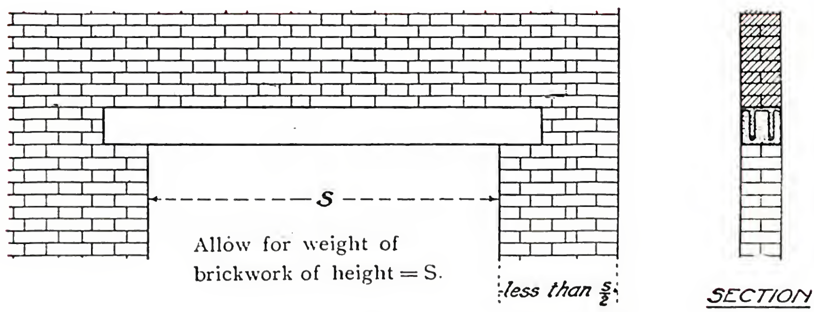


Fig. 11.

Where a lintol is close to the end of a wall and the width of pier between one end of the lintol and the corner of the wall is less than half the span of the opening under the lintol, the load on the lintol should be taken as the full weight of brickwork of a height equal to the span, unless, of course, the actual height of brickwork over the lintol is less than this. For weights of brickwork see Table following Condition 3.

CONDITION 3

BOTH ENDS OF LINTOL CLOSE TO END OF WALL

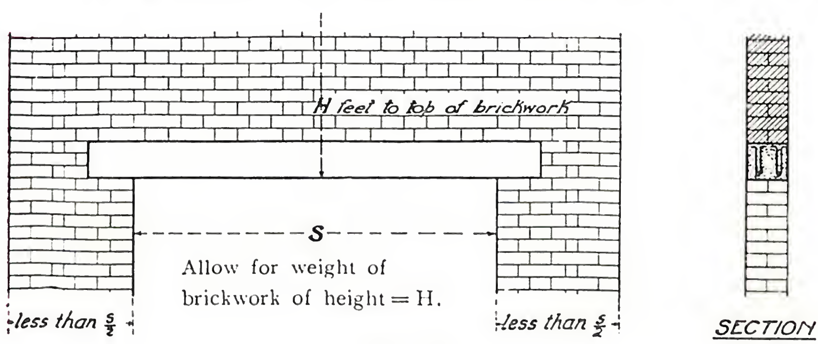


Fig. 12.

Where both ends of a lintol are close to the ends of the wall, *e.g.*, where a lintol spans an opening in a short wall, the load should be taken as the weight of the full height of brickwork over the lintol.

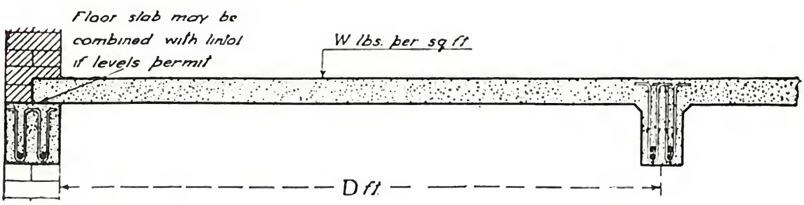
The following table gives the full Weight in lbs. per foot run for various Heights and Thicknesses of Brick Wall.

WEIGHT OF BRICK WALLS—

Thickness of wall (ins.)	WEIGHT OF WALL—Lbs. per ft. run											
	HEIGHT IN FEET.											
	1	2	3	4	5	6	7	8	9	10	20	30
$4\frac{1}{2}$	45	90	135	180	225	270	315	360	405	450	900	1350
9	90	180	270	360	450	540	630	720	810	900	1800	2700
$13\frac{1}{2}$	135	270	405	540	675	810	945	1080	1215	1350	2700	4050
18	180	360	540	720	900	1080	1260	1440	1620	1800	3600	5400
$22\frac{1}{2}$	225	450	675	900	1125	1350	1575	1800	2025	2250	4500	6750

CONDITION 4

FLOOR JOISTS OR SLAB RESTING ON OR OVER LINTOL.



Allow for load from floor $= \frac{WD}{2}$ lbs. per ft. run of lintol.

FIG. 13.

Where floor slab or floor joists rest on a lintol, or on the brickwork above a lintol, the additional load to be allowed for per foot length of lintol in respect thereof is $L = \frac{WD}{2}$

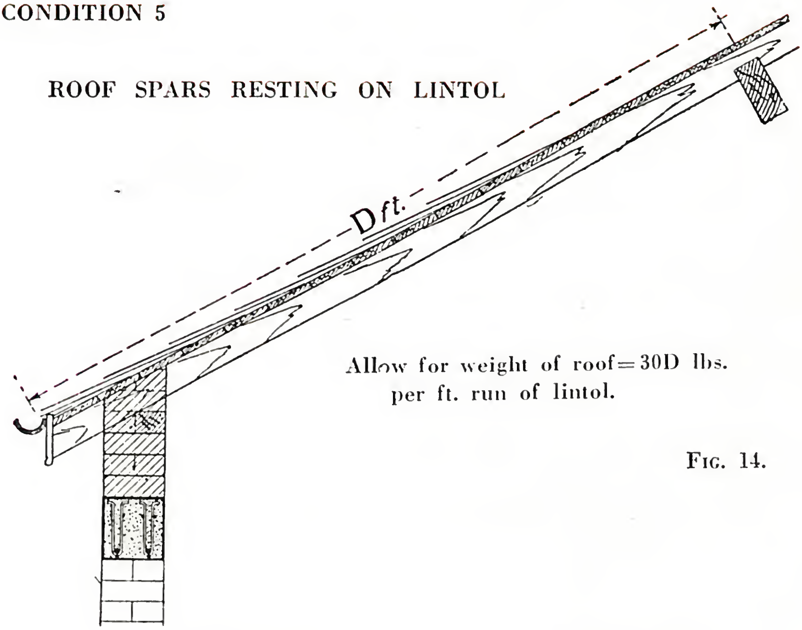
Where L = Additional load in lbs. per ft. run.

W = Floor load (including weight of floor) in lbs. per sq. ft. of floor area.

D = Span of floor slab or joists in feet (*i.e.*, distance from lintol to nearest beam).

CONDITION 5

ROOF SPARS RESTING ON LINTOL



Allow for weight of roof = 30D lbs. per ft. run of lintol.

FIG. 14.

Where roof spars rest on a lintol, or on the brickwork above a lintol, the additional load to be allowed for per ft. length of lintol in respect thereof is

$$L = 30\ D.$$

Where L = Additional load in lbs. per ft. run.

D = Distance from wall to nearest purlin in feet.

OTHER CONDITIONS

Where a concentrated load, such as a roof truss or a main beam, rests on a lintol, the equivalent uniformly distributed load should be calculated and added to the other loads which are carried by the lintol.

SHAPE OF LINTOLS

Lintols can be made without difficulty to any shape, and the underside rebated to suit any type of window frame.

PRE-CAST LINTOLS.

When lintols are made on the ground in moulds the top side should be very distinctly marked, in order to avoid risk of subsequently handling or placing them wrong way up

LINTOL BEAMS.

Calculated with ends freely supported. Reinforced with round steel bars and B.R.C. stirrups.

SAFE LOADS

Lbs. per ft. Run of Lintol.

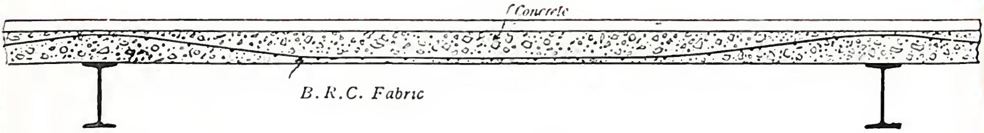
The following table must only be used where the bars are fitted with B.R.C. stirrups to resist shearing stresses:—

TABLE 6.

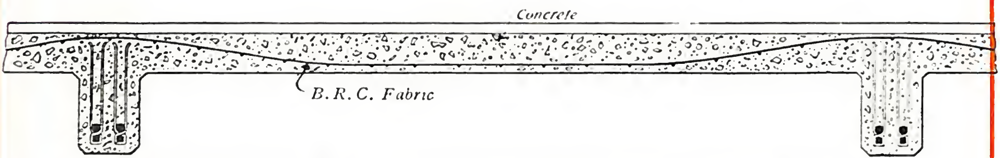
Reference No.	Width of Beam (*ins*)	Depth of Beam in Courses of Brickwork	No. of Bars	Diam. of Bars (Round) (*ins.*)	SPAN IN FEET 3	4	5	6	7	8	10	12	16	20
L11		2	1	½	870	490	310	220	160	120	80			
L12		2	1	⅝	1030	580	370	260	190	150	90			
L13	4½	3	1	⅝	2160	1220	780	540	400	310	200	140		
L14		3	1	¾	2450	1380	880	610	450	340	220	150		
L15		4	1	¾	4220	2380	1520	1060	780	590	380	260	150	
L16		4	1	⅞	4620	2600	1660	1150	850	650	420	290	160	
L21		2	2	½	1750	980	630	440	320	250	160			
L22		2	2	⅝	1960	1100	710	490	360	280	180			
L23	9	3	2	⅝	4340	2440	1560	1080	800	610	390	270		
L24	to	3	2	¾	4850	2750	1760	1220	900	690	440	310		
L25	11	4	2	¾	8450	4760	3040	2120	1550	1190	760	530	300	
L26		4	2	⅞		5190	3320	2300	1690	1300	830	580	320	
L27		5	2	⅞		7880	5040	3500	2570	1970	1260	880	490	320
L28		5	2	1		8320	5330	3700	2720	2080	1330	930	520	330
L31		2	3	½	2570	1450	930	640	470	360	230			
L32		2	3	⅝	2950	1660	1070	740	540	420	270			
L33		3	3	⅝	6480	3650	2340	1620	1190	910	580	410		
L34	11	3	3	¾	7300	4100	2620	1820	1330	1030	660	460		
L35	to	4	3	¾		7050	4520	3140	2300	1770	1130	790	440	
L36	14	4	3	⅞		7820	5000	3470	2550	1950	1250	870	490	
L37		5	3	⅞			7540	5220	3840	2940	1880	1300	740	470
L38		5	3	1			8000	5560	4090	3120	2000	1390	780	500

B.R.C. Fabric in Floors

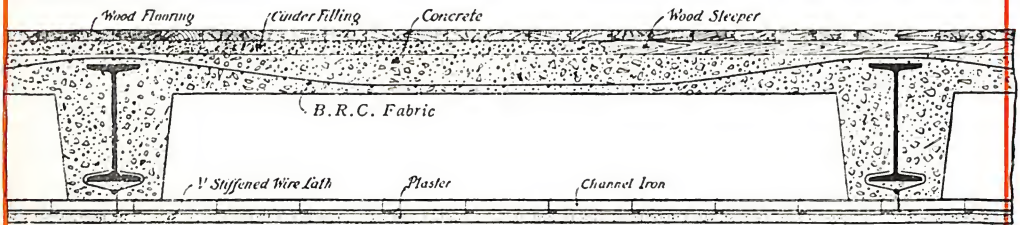
TYPES OF FLOORS IN EVERYDAY USE.



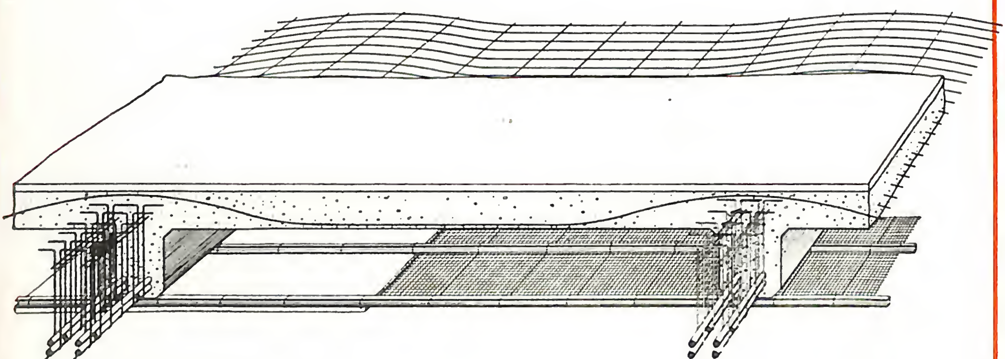
Plain Concrete Floor, supported by Steel Beams.



Plain Concrete Floor, supported by Reinforced Concrete Beams.



Boarded Concrete Floor, with or without Hollow Ceiling, supported by Steel Beams, showing use of B.R.C. Steel Wire Mesh for Binding Concrete Round Bottom Flange of Beam.



Example of Floor to carry distributed safe load of 210 lbs. per sq. foot.

Fig 15.

FLOOR SLABS

DESIGN OF FLOORS

In designing ordinary floors it is the custom to assume that the floor may have to carry a certain evenly distributed load, depending in amount on the purpose for which the floor is to be used. It is seldom that such evenly distributed loading actually does occur, except in the case of warehouse buildings, where goods are piled in a regular manner, but it is impossible to gauge exactly how a floor will be loaded, and the assumption of an evenly distributed load, sufficient to provide for unusual loads (such as, for instance, when a room in a dwelling-house or office building may become crowded with people) is a rational treatment, and at the same time simplifies the design.

In cases such as those of floors required to carry heavy machinery, large safes, and the like, special designs are necessary.

EVENLY DISTRIBUTED LOADS

The evenly distributed loads to be provided for as mentioned above are in certain districts specified by Local Building Authorities, and they vary somewhat.

The following are typical:—

Class of Building	Loads on Floor in Lbs. per Ft. Super			
	Melb'rne (1923)	Sydney (1917)	Adelaide (1923)	London (1915)
Domestic Buildings	70	50	50	70
Office Buildings, 1st Floor ..	84	60	60	100
,, ,, above 1st Floor	84	60	60	100
Buildings for Public Assembly	140	100	100	112
Workshop or Retail Shop ..	140	100	100	112
Ordinary Warehouses ..	168	150	150	224
Flat Roofs	70	120	120	—

WEIGHT OF FLOOR ITSELF

In addition to the superimposed loads, it should be remembered that the Weight of the actual Floor itself must be taken into account, and, as this will vary approximately between 30 and 100 lbs. per square foot for ordinary cases, it is an important item.

The following are Weights per square foot for Different Thicknesses of Reinforced Concrete Floor, reckoned at 150 lbs. per cubic foot:—

Thickness of Floor in inches ..	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5	$5\frac{1}{2}$
Weight of Floor in lbs. per ft. super	31	38	44	50	56	63	69
Thickness of Floor in inches ..	6	$6\frac{1}{2}$	7	$7\frac{1}{2}$	8	$8\frac{1}{2}$	9
Weight of Floor in lbs. per ft. super	75	81	88	94	100	106	113

The loads given in our Tables are the Evenly Distributed Safe Loads that may be superimposed. The weight of the reinforced concrete floor has been allowed for and deducted. Such tables are more convenient for use than tables from which the user has to make a deduction for the weight of the floor itself. It is sometimes suggested that this deduction need not be made, or it is treated in an offhand way, as being a matter of little importance, which may or may not be taken into account. Such treatment is equivalent to a reduction in the recognised factor of safety. It is bad practice and introduces an unjustifiable risk.

END SUPPORTS

The Stresses which occur in a Floor, due to the weight it has to carry (partly its own weight and partly the superimposed evenly distributed load), will vary with the manner in which the ends are supported.

Where the ends are supported "freely" the Bending, measured in terms of the Bending Moment (B.M.), is greatest at the centre and $= \frac{wL^2}{8}$ per ft. width, where w = load per square foot, and L = length

of span (feet). It decreases from the centre towards each end, where it becomes zero.

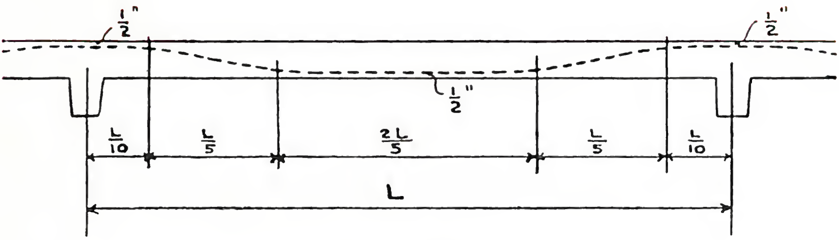
Where the ends are absolutely "fixed" the B.M. at the centre $= \frac{wL^2}{24}$ decreasing to zero at about 1-5th of the length from each end, and then increasing again (but in the opposite direction, that is, producing a tendency to bend upwards) to the ends, where it is a maximum and $= \frac{wL^2}{12}$

A partial fixing of the ends will give a Bending Moment of $\frac{wL^2}{12}$ at the centre, decreasing to zero at about 1-10th of the length from each end, and then increasing again to $\frac{wL^2}{24}$ at the ends. Between these two conditions, there is a large range of more or less complete fixing where the Bending Moment at the ends is equal to or less than $\frac{wL^2}{12}$ and the Bending Moment at the centre is correspondingly less than or equal to $\frac{wL^2}{12}$. There is one condition of fixing between these two limits, where the Bending Moment at ends and centre each $= \frac{wL^2}{16}$. This is the most favourable condition, but as it can only occur over an extremely small range in variation of fixing, loading, and reinforcing, it is neither justifiable nor safe to assume that it is the condition which should be provided for.

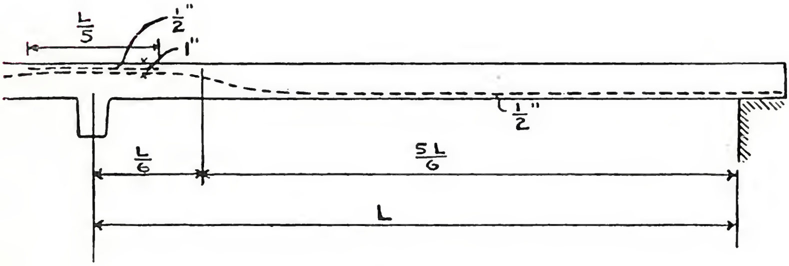
TABLES

We have in common with other good practice, and as recommended by the R.I.B.A., adopted the value $\frac{wL^2}{12}$ as the Basis of our Tables. This value holds for perfectly fixed ends, and also covers a considerable range of partially fixed ends, and these are the *conditions that most frequently arise in practice,* the commonest case being that of a floor, roof, or similar surface supported by a series of steel or reinforced concrete beams which divide the surface into a large number of short, continuous spans. It is necessary that the reinforcement should be correctly continuous, and this is a condition which B.R.C. Fabric essentially fulfils. The Fabric should be laid half-an-inch from the underside of the concrete in the middle portion of the span, and then brought up to half-an-inch from the top of the concrete over the supports (see top diagram, Fig. 16).

DIAGRAM FOR POSITION OF REINFORCEMENT IN SLABS

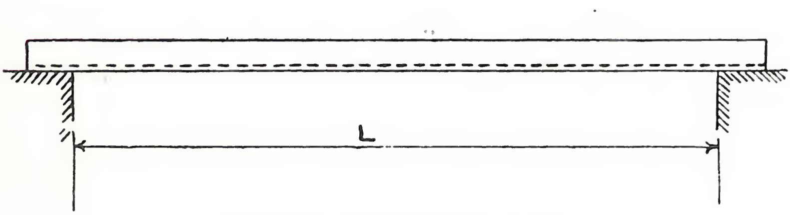


Ordinary Bay.



End Bay.

CONTINUOUS SPANS.



FREELY SUPPORTED SPAN.

Fig. 16.

In the case of continuous spans, the Bending Moments over the majority of the supports $= \frac{wL^2}{12}$, and this is the maximum Bending Moment except in the End Bays, where the spans are as a rule freely supported at the outer end; this may increase the Bending Moment over the support next to the free end, and it is advisable to put in not less than 20 per cent. extra reinforcement over this support for a width equal to one-fifth of the span (see middle diagram, Fig. 16); or the length of the end span may be made equal to nine-tenths of the other spans, and extra reinforcement will not then be necessary.

In the case of Spans with both ends Freely Supported, such as often occurs with single spans, the Fabric should be laid flat, half an inch from the underside of the concrete (see bottom diagram, Fig. 16).

The *Tabulated Loads* are the Safe Superimposed Loads for Continuous Spans.

The Safe Superimposed Loads for Freely Supported Spans are less than these, being two-thirds of the Tabulated Loads, less one-third the weight of the concrete floor, thus for floor 5" inch thick, reinforcement No. 7, span 7 ft., the safe load for freely supported span $= \frac{2}{3}$ (315)—21= 189 lbs.

Where the thickness of floor is not already determined by other considerations, the most economical floor to adopt is that in which the concrete and the reinforcement are stressed in proportion to their respective strengths. Table 8 is for floors so selected, each thickness of floor being combined with the reinforcement most suited to it.

In many cases the thickness of concrete is approximately settled beforehand, and it is required to select a reinforcement to enable a certain load to be carried. We give a complete table for each thickness of floor (increasing by $\frac{1}{2}$ inches from $2\frac{1}{2}$ inches to $8\frac{1}{2}$ inches), combined with each of our standard sizes of reinforcement.

The thickness of floor should not be less than one-thirtieth of the span.

The tables give a complete range of sizes for all ordinary cases of floors, roofs, and the like.

TABLE 7

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE AND REINFORCEMENT PROPORTIONED FOR MAXIMUM ECONOMY

Reference No for Fabric	Thickness of Concrete (ins.)	Approx. W'ght of Floor per sq. ft. (lbs.)	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER. SPAN IN FEET 3	4	5	6	7	8	9	10	11	12	13	14
1	8½	106	6694	3714	2337	1594	1144	850	649	506	399	319	256	206
2	8½	106	6444	3584	2254	1534	1099	817	622	484	382	304	244	195
3	8½	106	5994	3274	2054	1394	994	737	550	434	340	269	214	169
4	8½	106	5094	2819	1769	1194	850	625	472	362	281	219	171	133
4	8	100	4820	2660	1670	1129	802	590	446	342	265	207	162	126
5	7½	94	3856	2126	1326	891	631	461	344	261	199	152	116	87
5	7	88	3502	1932	1202	810	582	417	311	235	179	136	103	77
6	6½	81	2779	1524	947	634	444	321	236	176	131	97	71	50
6	6	75	2495	1370	850	567	399	287	211	156	116	85	62	41
7	5½	69	1887	1031	636	421	291	206	138	107	76	53	35	
7	5	63	1657	904	557	367	253	179	128	92	65	44		
8	4½	56	1262	685	418	273	186	129	90	62	42			
9	4	50	880	473	285	182	121	81	53	34				
10	3½	44	612	326	192	120	77	49	29					
11	3	38	408	212	123	73	44	25						
12	2½	31	255	130	72	41	22							

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct one-third weight of floor (3rd column).

TABLE 8

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 2½″ THICK

Reference No. for Fabric (see page 28)	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER. SPAN IN FEET 3	4	5	6	7	8	9	10	11	12	13	14
1	516	277	166	106	70	46	30					
2	501	268	161	102	67	44	28					
3	489	261	156	99	64	42	27					
4	472	251	150	95	61	40	25					
5	443	235	139	87	56	36						
6	419	223	131	81	52	32						
7	399	201	123	76	48	29						
8	379	199	116	71	44	27						
9	349	183	106	64	39	23						
10	319	167	95	57	34							
11	301	155	88	52	30							
12	255	130	72	41	22							
13	203	100	53	28								
14	157	75	37	16								

For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 10 lbs. (i.e., one-third weight of floor).

TABLE 9

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 3″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER.											
	SPAN IN FEET											
	3	4	5	6	7	8	9	10	11	12	13	14
1	842	457	278	182	124	86	60	41	28			
2	792	430	262	170	115	79	55	37				
3	762	412	250	162	109	75	51	34				
4	727	392	237	153	102	70	47	31				
5	692	372	225	145	96	65	43	28				
6	652	350	210	135	89	60	39	24				
7	612	327	196	125	82	53	34					
8	577	308	183	115	75	48	30					
9	530	292	166	104	66	42	25					
10	490	259	152	94	59	36						
11	408	212	123	73	44	25						
12	341	175	99	57	34							
13	273	137	74	40	19							
14	220	107	55	26								

For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 13 lbs. (i.e., one-third weight of floor).

TABLE 10

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 3½″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER.											
	SPAN IN FEET											
	3	4	5	6	7	8	9	10	11	12	13	14
1	1181	646	396	262	181	128	92	66	47	33		
2	1126	616	278	249	171	121	86	61	43	29		
3	1086	591	363	238	164	115	82	58	40	27		
4	1026	564	346	226	155	108	76	53	36			
5	986	536	326	213	145	101	70	49	32			
6	926	501	304	198	134	92	64	43	28			
7	856	461	279	180	121	82	56	37				
8	804	432	261	168	111	75	50	32				
9	734	392	236	150	99	65	42	26				
10	612	326	192	120	77	49	29					
11	521	274	160	97	60	35	19					
12	431	222	127	75	43	23						
13	350	177	98	54	28							
14	268	132	68	34								

For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 15 lbs. (i.e., one-third weight of floor).

TABLE 11

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 4″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER.											
	SPAN IN FEET											
	3	4	5	6	7	8	9	10	11	12	13	14
1	1575	864	535	356	249	179	131	96	71	52	37	
2	1503	825	510	339	236	169	123	90	66	47	33	
3	1450	790	489	324	225	160	116	85	61	43	30	
4	1380	750	464	306	212	150	109	78	56	39		
5	1320	720	443	292	201	142	102	73	52	35		
6	1220	675	407	268	184	129	91	64	44	29		
7	1135	620	377	246	168	117	82	58	38			
8	1050	570	346	225	152	105	72	49	32			
9	880	473	285	182	121	81	53	34	19			
10	740	395	234	148	95	61	38	21				
11	628	331	194	119	74	45	25					
12	515	268	153	91	54	29						
13	415	212	118	66	35							
14	345	172	92	48								

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 17 lbs. (i.e., one-third weight of floor).

TABLE 12

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 4½″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER.											
	SPAN IN FEET											
	3	4	5	6	7	8	9	10	11	12	13	14
1	2024	1114	692	464	326	236	175	131	99	74	54	38
2	1934	1064	662	442	310	224	165	123	92	69	50	35
3	1860	1022	634	424	296	213	157	116	86	64	46	32
4	1744	956	593	394	275	198	144	106	78	56	40	27
5	1654	856	559	371	258	186	134	98	71	51	35	
6	1523	833	512	339	234	164	119	86	61	43	28	
7	1454	789	485	322	220	156	111	79	56	38		
8	1262	685	418	273	186	129	90	62	42	26		
9	1033	556	336	216	144	97	65	42	25			
10	864	462	275	174	113	73	46	27				
11	733	387	228	141	89	55	31					
12	620	324	187	113	68	39						
13	527	272	154	89	51	26						
14	454	230	128	72	38							

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 19 lbs. (i.e., one-third weight of floor).

TABLE 13

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 5″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER. SPAN IN FEET											
	3	4	5	6	7	8	9	10	11	12	13	14
1	2507	1382	862	579	409	298	222	168	128	97	74	55
2	2387	1331	817	549	387	281	209	157	119	90	67	49
3	2287	1257	782	524	367	267	198	149	112	84	62	45
4	2167	1187	740	490	346	250	185	138	102	76	56	39
5	2017	1107	687	457	319	230	168	124	92	67	48	33
6	1927	1055	652	434	302	217	158	116	85	61	43	28
7	1657	904	557	367	253	179	128	92	65	44	29	
8	1417	767	469	307	209	145	101	70	47	29		
9	1197	640	390	252	168	114	77	50	31			
10	1002	537	321	203	133	87	55	33				
11	857	455	269	167	106	66	39	20				
12	662	372	216	121	79	46	23					
13	617	317	181	113	62	32						
14	440	237	129	79	35							

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 21 lbs. (i.e., one-third weight of floor).

TABLE 14

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 5½″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER. SPAN IN FEET											
	3	4	5	6	7	8	9	10	11	12	13	14
1	3006	1661	1036	701	4[illegible]6	363	273	207	159	123	95	72
2	2891	1591	991	671	473	346	259	197	151	116	88	67
3	2731	1506	939	631	446	325	242	183	139	106	80	60
4	2581	1421	886	594	417	303	225	169	128	96	72	52
5	2431	1336	831	556	391	283	209	156	117	87	64	46
6	2221	1216	754	503	351	253	185	137	101	74	53	36
7	1887	1031	636	421	291	206	138	107	76	53	35	21
8	1621	881	539	353	241	168	118	83	56	36	21	
9	1381	845	451	293	206	135	92	61	38	21		
10	1136	611	356	233	162	101	65	39	21			
11	951	506	299	187	119	75	44	23				
12	835	439	256	157	97	58	31					
13	653	337	192	112	64	32						
14												

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 23 lbs. (i.e., one-third weight of floor).

TABLE 15

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 6″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER.											
	SPAN IN FEET											
	3	4	5	6	7	8	9	10	11	12	13	14
1	3555	1965	1235	833	593	436	329	251	195	152	118	92
2	3357	1862	1165	786	558	410	308	235	181	140	105	83
3	3190	1760	1105	742	525	385	288	219	168	129	99	75
4	3005	1655	1035	695	490	358	267	202	154	117	89	66
5	2865	1575	980	659	465	338	248	189	143	109	81	60
6	2495	1370	850	567	399	287	211	156	116	85	62	41
7	2090	1143	705	466	323	230	166	120	86	60	40	24
8	1795	975	599	393	269	185	133	93	64	42	25	
9	1465	791	480	310	208	141	96	63	39	21		
10	1246	668	401	255	168	111	72	44	23			
11	1063	565	335	209	134	85	51	27				
12	950	503	295	181	114	69	39					
13	769	400	228	136	80	43						
14												

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 25 lbs. (i.e., one-third weight of floor).

TABLE 16

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 6½″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER.											
	SPAN IN FEET											
	3	4	5	6	7	8	9	10	11	12	13	14
1	4139	2297	1439	974	695	513	389	299	233	183	144	113
2	3919	2169	1359	919	654	482.	364	279	217	169	132	103
3	3709	2049	1281	865	614	451	339	259	200	156	121	93
4	3529	1949	1219	823	582	427	319	244	187	145	111	85
5	3219	1779	1109	744	525	384	286	216	165	125	94	71
6	2779	1524	947	634	444	321	236	176	131	97	71	50
7	2299	1259	775	514	356	253	183	133	96	67	46	28
8	1989	1079	664	436	299	210	149	105	73	48	29	
9	1639	884	537	349	235	160	110	73	47	30		
10	1369	736	442	282	185	123	80	50	27			
11	1239	662	395	249	162	105	66	38				
12	975	513	299	183	113	68	36					
13												
14												

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 27 lbs. (i.e., one-third weight of floor).

TABLE 17

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 7″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER. SPAN IN FEET 3	4	5	6	7	8	9	10	11	12	13	14
1	4752	2632	1652	1122	800	592	450	347	272	214	170	134
2	4492	2492	1562	1054	752	556	421	324	252	198	156	122
3	4232	2342	1467	992	706	520	392	300	233	182	142	110
4	4072	2252	1412	952	676	497	374	286	222	172	134	103
5	3502	1932	1202	810	582	417	311	235	179	136	103	77
6	2973	1636	1012	677	575	343	253	188	140	104	75	53
7	2512	1372	847	562	390	278	201	146	105	74	50	31
8	2127	1168	717	471	323	226	160	113	78	52	31	14
9	1832	992	604	392	265	182	126	85	55	32		
10	1522	818	492	315	208	138	91	57	32			
11	1317	702	417	263	170	110	68	38				
12	1111	585	342	132	80	45						
13												
14												

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 29 lbs. (i.e., one-third weight of floor).

TABLE 18

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 7½″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER. SPAN IN FEET 3	4	5	6	7	8	9	10	11	12	13	14
1	5436	3016	1896	1283	919	683	521	403	316	251	200	160
2	5056	2806	1756	1194	852	630	478	370	289	228	180	142
3	4881	2706	1696	1146	820	606	458	353	276	216	170	134
4	4466	2466	1546	1046	743	547	412	316	245	187	149	115
5	3856	2126	1326	891	631	461	344	261	199	152	116	87
6	3246	1781	1106	741	519	376	277	206	154	114	84	59
7	2821	1546	960	636	441	316	230	168	123	88	61	40
8	2396	1306	801	528	363	256	182	130	91	61	28	20
9	2026	1097	669	436	296	204	144	97	64	38	19	
10	1729	930	562	361	241	162	108	70	41			
11	1486	795	476	301	196	128	81	48	23			
12	1118	587	342	210	129	77	41	15				
13												
14												

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 31 lbs. (i.e., one-third weight of floor).

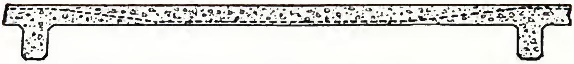


TABLE 19

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 8″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER. SPAN IN FEET 3	4	5	6	7	8	9	10	11	12	13	14
1	6975	3365	2120	1440	1034	770	586	455	359	286	229	184
2	5730	3180	2000	1359	970	720	549	424	333	264	210	168
3	5370	2980	1871	1269	905	670	508	392	306	242	191	151
4	4820	2660	1670	1129	802	590	446	342	265	207	162	126
5	4050	2230	1390	935	661	484	360	273	208	159	121	91
6	3560	1960	1219	815	572	415	307	229	172	128	95	68
7	2990	1640	1010	672	468	334	243	178	130	93	64	42
8	2570	1400	860	566	390	275	196	140	98	67	42	22
9	2220	1204	735	480	326	226	158	109	72	45	23	
10	1868	1007	610	392	262	176	119	77	46	23		
11	1575	849	506	322	210	137	87	52	25			
12												
13												
14												

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 33 lbs. (i.e., one-third weight of floor).

TABLE 20

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 8½″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER. SPAN IN FEET 3	4	5	6	7	8	9	10	11	12	13	14
1	6694	3714	2337	1594	1144	850	649	506	399	319	256	206
2	6444	3584	2254	1534	1099	817	622	484	382	304	244	195
3	5994	3274	2054	1394	994	737	550	434	340	269	214	169
4	5034	2819	1769	1194	850	625	472	362	282	219	171	133
5	4374	2414	1514	1014	718	524	392	297	227	174	132	100
6	3814	2097	1306	834	614	446	330	247	186	139	103	74
7	3174	1739	1074	714	497	355	258	189	138	99	69	44
8	2854	1554	957	634	437	310	223	160	114	79	51	28
9	2374	1285	786	514	349	242	169	117	78	49	26	
10	2054	1104	669	434	290	197	134	88	54	29		
11	1734	929	557	354	232	153	98	60	31			
12												
13												
14												

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 35 lbs. (i.e., one-third weight of floor).

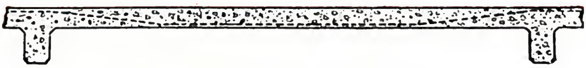


TABLE 21

FLOOR SLABS—Continuous, or with ends fixed. Reinforced with B.R.C. Fabric. The weight of the floor itself has been deducted, and no allowance is necessary in respect thereof.

CONCRETE 9″ THICK

Reference No. for Fabric	SAFE LOADS—UNIFORMLY DISTRIBUTED—LBS. PER FT. SUPER.											
	SPAN IN FEET											
	3	4	5	6	7	8	9	10	11	12	13	14
1	7517	4167	2627	1792	1287	957	734	573	453	363	293	237
2	7137	3967	2497	1702	1217	907	693	540	427	340	273	220
3	6237	3457	2169	1473	1053	782	593	458	359	284	225	179
4	5427	2997	1877	1268	905	667	502	385	298	233	182	141
5	4787	2637	1647	1108	786	574	430	327	251	192	147	111
6	4147	2287	1422	952	670	487	361	271	204	153	114	83
7	3507	1927	1192	793	553	397	290	213	156	113	80	53
8	2977	1627	998	659	455	322	231	165	117	80	51	29
9	2607	1418	867	567	387	270	189	132	89	57	32	12
10	2067	1111	670	432	287	193	129	83	49	23		
11	1887	1012	607	387	255	168	109	67	36			
12												
13												
14												

For Loads to the left of the heavy line, B.R.C. Stirrups must be used to resist Shearing Stresses. For Safe Loads on Slabs with ends "Freely supported" take two-thirds of above loads and deduct 37 lbs. (i.e., one-third weight of floor).

B.R.C. FABRIC FLOOR SLAB TABLES.

THE TABLES

The tables herewith show the size of Fabric to be used for various classes of floors over various spans. *They are for floors continuous over a number of spans,* but may be used for end spans and freely-supported spans as described in the paragraph headed "Types of Span." The full factor of safety is provided on the weight of the floor itself in addition to the load given at the head of each table, which is the *safe superimposed load.*

TYPE OF WIRE

The wire used is best quality mild steel. The tensile strength varies from 80,000 to 100,000 lbs. per square inch. The elastic limit averages 65,000 lbs. per square inch.

SAFE WORKING STRESSES

The working stress allowed on the concrete is *600 lbs. compression per square inch* in all cases. The working stress allowed on the steel wire is *20,000 lbs. tension per square inch;* 25,000 lbs. per square inch is one-third of the stress at the elastic limit; it is the figure we recommend, and *may be used with every confidence.* It is safer than using rolled mild steel rods at 16,000 lbs. per square inch, or steel joists at $7\frac{1}{2}$ tons per square inch, both of which are standard practice. In some cases local authorities do not discriminate between drawn steel wire and rolled steel rods (although the former are 50 per cent. stronger), and insist on a maximum stress of 20,000 or 16,000 lbs. per sq. in.

USE OF TABLES.

The figures in each table give Standard Reference No. of B.R.C. Fabric to be used for the purpose of loading indicated at the head of the table. For instance—to carry a safe superimposed load of 2 cwts. per sq. ft. over a span of 8 ft., using concrete 6 in. thick, No. 7 Standard Fabric should be used. No. 7 Standard (see table of Standard Sizes) consists of longitudinal wires No. 3 gauge, spaced 3 in. apart, with transverse wires No. 6 gauge spaced 16 in. apart. If the thickness of concrete is not determined by other considerations, it is most economical to select the size of Fabric immediately above the heavy black line, and use the corresponding thickness of concrete shown in the left-hand column. The thickness of floor slab should not be less than one-thirtieth of the span.

B.R.C. FLOOR SLAB TABLES

FOR CONTINUOUS SPANS.

FOR ROOFS

SAFE SUPERIMPOSED LOAD. 40 LBS. PER SQUARE FT.

Thickness of Concrete (ins.)	SPAN IN FEET								
	6	7	8	9	10	11	12	13	14
	No.	No.	No.	No.	No.	No	No.	No.	No.
3	13	11	9	5	1				
3½	13	12	10	9	6	3			
4	14	12	11	9	8	6	3		
4½		13	11	10	9	8	6	4	
5		13	12	10	9	8	7	6	3
5½		13	12	11	9	8	7	6	5
6			13	11	10	8	8	7	6
6½				11	10	9	8	7	6
7				12	11	10	9	8	7
7½				12	11	10	9	8	7
8					11	10	9	8	7
8½					11	10	9	8	7
9					11	10	9	8	7

FOR OFFICES AND DWELLINGS

SAFE SUPERIMPOSED LOAD—84 LBS. (¾-CWT.) PER SQUARE FT.

Thickness of Concrete (ins.)	SPAN IN FEET								
	6	7	8	9	10	11	12	13	14
	No.	No.	No.	No.	No.	No.	No.	No.	No.
3	10	6	1						
3½	11	9	6	2					
4	12	10	8	6	3				
4½	13	11	9	8	6	3			
5	13	11	10	8	7	6	3		
5½	13	12	10	9	7	6	5	2	
6	13	12	11	9	8	7	6	4	1
6½		12	11	9	8	7	6	5	4
7			11	10	9	7	6	5	4
7½			11	10	9	8	7	6	5
8				11	9	8	7	6	5
8½				11	10	8	7	6	5
9				11	10	9	7	6	5

FOR SCHOOLS, SHOPS, & PUBLIC BUILDINGS

SAFE SUPERIMPOSED LOAD—112 LBS. (1 CWT.) PER SQUARE FT.

Thickness of Concrete (ins.)		SPAN IN FEET								
		6	7	8	9	10	11	12	13	14
		No.	No.	No.	No.	No.	No.	No.	No.	No.
3		8	2							
	3½	10	7	3						
4		11	9	7	3					
	4½	12	10	8	6	3				
5		13	10	9	7	6	3			
	5½	13	11	9	8	6	5	2		
6		13	12	9	8	7	6	4	1	
	6½		12	10	8	7	6	5	3	1
7				10	9	8	6	5	4	2
	7½			11	9	8	7	6	5	4
8				11	10	8	7	6	5	4
	8½			11	10	9	8	6	5	4
9				11	10	9	8	7	6	4

FOR BALL ROOMS AND DRILL HALLS

SAFE SUPERIMPOSED LOAD—168 LBS. (1½ CWT.) PER SQUARE FT.

Thickness of Concrete (ins.)		SPAN IN FEET								
		6	7	8	9	10	11	12	13	14
		No.	No.	No.	No.	No.	No.	No.	No.	No.
3		2								
	3½	8	2							
4		9	7	2						
	4½	10	8	5	1					
5		10	9	7	5	1				
	5½	11	9	8	6	4	1			
6		12	10	8	6	5	3			
	6½	12	10	8	7	6	4	2		
7			11	9	7	6	5	4	1	
	7½		11	9	8	7	5	4	3	
8			11	10	8	7	6	4	3	2
	8½		11	10	9	7	6	5	4	3
9				11	9	7	6	5	4	3

FOR WAREHOUSES

SAFE SUPERIMPOSED LOAD—224 LBS. (2 CWT.) PER SQUARE FT.

Thickness of Concrete (ins.)	SPAN IN FEET								
	6	7	8	9	10	11	12	13	14
	No.	No.	No.	No.	No.	No	No.	No.	No
3									
3½	4								
4	8	3							
4½	8	6	2						
5	9	7	5						
5½	10	8	6	4					
6	10	8	7	5	2				
6½	11	9	7	6	4	1			
7	11	9	8	6	5	3			
7½	11	10	8	7	5	4	2		
8	11	10	9	7	6	4	3	1	
8½		11	9	7	6	5	3	2	
9		11	9	8	6	5	4	3	1

FOR WAREHOUSES

SAFE SUPERIMPOSED LOAD—280 LBS. (2½ CWT.) PER SQUARE FT.

Thickness of Concrete (ins.)	SPAN IN FEET								
	6	7	8	9	10	11	12	13	14
	No.	No.	No.	No.	No.	No.	No.	No.	No.
3									
3½									
4	5								
4½	7	3							
5	8	6	2						
5½	9	7	5						
6	9	7	6	3					
6½	10	8	6	5	1				
7	10	8	6	5	4				
7½	11	9	7	5	4	2			
8	11	9	7	6	4	3	1		
8½	11	10	8	6	5	4	2		
9	11	10	8	7	5	4	3	1	

FOR HEAVY WAREHOUSES

SAFE SUPERIMPOSED LOAD—336 LBS. (3 CWT.) PER SQUARE FT.

Thickness of Concrete (ins.)	SPAN IN FEET								
	6	7	8	9	10	11	12	13	14
	No.	No.	No.	No.	No.	No.	No.	No.	No.
3									
3½									
4									
4½	6								
5	7	4							
5½	8	6	2						
6	8	6	5						
6½	9	7	5	3					
7	9	7	6	4	1				
7½	10	8	6	5	3				
8	10	8	6	5	4	1			
8½	11	9	7	5	4	3			
9	11	9	7	6	4	3	2		

FOR HEAVY MACHINERY

SAFE SUPERIMPOSED LOAD—448 LBS. (4 CWT.) PER SQUARE FT.

Thickness of Concrete (ins.)	SPAN IN FEET								
	6	7	8	9	10	11	12	13	14
	No.	No.	No.	No.	No.	No.	No.	No.	No.
3									
3½									
4									
4½									
5	5								
5½	6	2							
6	6	5							
6½	7	5	3						
7	8	6	4	1					
7½	8	6	5	3					
8	9	7	5	3	1				
8½	9	7	5	4	2				
9	9	8	6	4	3				

HOLLOW FLOORS.

Our Hollow Floors are used in Hospitals, Asylums, Schools, and the like, where quietness is required.

They are rather more expensive than ordinary floors.

They consist of Fireclay Hollow Tubes lying between Reinforced Concrete beams. The undersides of the tubes are flush with the under sides of the beams, so that the ceiling is flat. The beams are from two feet to two feet six inches apart.

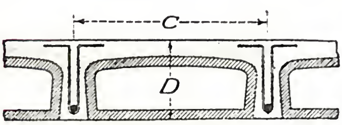
The floors being comparatively deep can be used for large spans, even with heavy loads.

The following table gives the safe loads per ft. super. for three sizes of floor. A range of loads is given for each size, the strength of the floor being varied by altering the strength of the reinforced concrete beams between which the tubes are supported, without changing the outside dimensions.

We provide floors for heavier loads and longer spans, but those tabulated are most commonly used.

TABLE 22

HOLLOW FLOORS—with ends freely supported. Reinforced with Round Steel Bars and B.R.C. Stirrups.



The following Table must only be used where the Reinforcing Bars are fitted with B.R.C. Stirrups to resist shearing stresses

Unit No	C (see above figure.)	Depth of Tile	D (see above figure.)	Approx. wt. of floor per sq. ft.	SAFE LOADS—UNIFORMLY DISTRIBUTED—IN LBS. PER SQ. FT.							
					SPAN IN FEET							
					8	10	12	14	16	18	20	22
H_9.21	2′ 0″	7″	9″	73 lbs.	145	68						
H_9.31					243	129	68					
H_9.41					350	198	115	65				
H_{12}.21	2′ 0″	10″	12″	73 lbs.	165	80						
H_{12}.12					228	120	60					
H_{12}.31					265	144	78					
H_{12}.41					378	215	128	75				
H_{12}.22					390	223	133	79				
H_{12}.51					518	306	190	120	75			
H_{12}.32					583	348	220	143	94			
H_{12}.42					813	493	320	216	149	102	70	
H_{12}.52					1048	643	426	293	208	149	107	76

FOUNDATIONS.

Reinforced Concrete is the most economical and most lasting form of construction for Foundation work. It is suitable both for wall foundations and column foundations, and is very much cheaper than either mass concrete or steel grillages.

The following are the allowable pressures per square foot on foundations in various classes of ground.

MATERIAL.	ALLOWABLE PRESSURE PER SQUARE FOOT (TONS)
Soft clay or sand slightly water-bearing .. .	1 to 2
Ordinary dry clay or dry sand mixed with clay	2 to 3
Dry sand or clay	3 to 4
Hard and firm clay or coarse sand	4 to 6
Firm coarse sand and gravel	6 to 8
Rock	15 upwards

WALL FOUNDATIONS

In bad ground, where the subsoil consists of peat, quicksand or unreliable material, the walls should be supported on B.R.C. Piles (Table 25). For single or two storey buildings the walls, if of brick, are either 9 inches or 14 inches thick; they carry their own weight, light floor loads, and light roof loads. The piles for these may be driven about 15 feet apart, with a rectangular B.R.C. Beam laid across on top of them to carry the wall. For heavier buildings the piles may require to be driven closer together.

Where the subsoil consists of soft clay, or sand slightly water-bearing, a pressure of from 1 to 2 tons per square foot may be allowed. The ground is frequently of variable reliability, being such that, although at most points a load of more than one ton per square foot might be allowed, there are weak spots where the allowed load should be less. For one or two storey buildings the loads are light and foundations comparatively narrow; in these cases it is more necessary that the foundations should be reinforced along the length of the wall than across the width of the wall, thus counteracting unequal settlement and preventing cracking of the brickwork. The concrete should be 2 feet 6 inches wide under 14 inch wall.

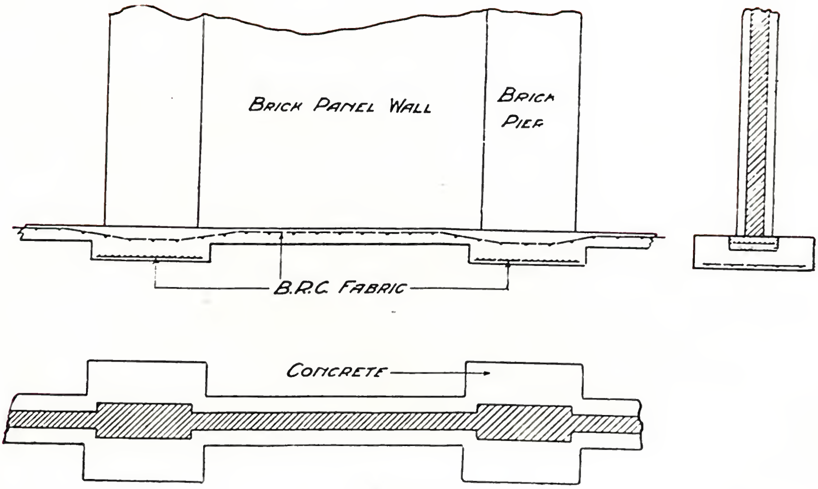


FIG. 17

and 2 feet wide under 9 inch wall, and in both cases 6 inches thick, reinforced with B.R.C. Fabric No. 5 laid longitudinally 1 inch above the bottom of the concrete. For heavier buildings the walls will consist of brick piers of various widths, with brick panels between, the piers being arranged to carry the greater part of the loads. The loads carried by the piers should be calculated per foot run, and the foundations proportioned in accordance with Table 23, the B.R.C. Fabric reinforcement being laid in sheets with the heavier close-spaced wires transverse to the wall. The foundations of the panel walls between the piers may be the same as for single or two storey buildings, but the reinforcement for such panels should be laid close to the top of the concrete and bent downwards towards and through the pier foundations. This method counteracts unequal settlement and prevents cracking of brickwork, which is otherwise liable to occur even where foundations are good. Fig. 17 illustrates the above.

Where the subsoil consists of ordinary dry clay, or dry sand mixed with clay, a pressure of from 2 to 3 tons per square foot may be allowed. Single or two storey buildings will not require reinforced foundations. Heavier buildings should have piers with foundations reinforced in accordance with Table 23, the panel walls being reinforced, as described in the preceding paragraph, to prevent cracking of brickwork.

Where the subsoil consists of dry sand or clay a pressure of from 3 to 4 tons per square foot may be allowed. Foundations should be dealt with in a similar manner to those described in the preceding paragraph.

Where the subsoil is firmer than the above, the wall foundations are very little wider than the walls themselves, and do not as a rule require reinforcement.

TABLE 23

FOUNDATIONS FOR BRICK PIERS

Reinforced with B.R.C. Fabric, laid 1 inch above the underside of the concrete.

The table may be used for any thickness of wall. The minimum thicknesses are tabulated merely as an approximate guide.

Loads per ft. run of Wall (tons) ..		2	3	4	6	8	10	12	14	16
Minimum Thickness of Brick Wall ..		9″	9″	9″	14″	14″	18″	18″	23″	27″
1 Ton per sq. ft. on Ground	Width of Concrete Foundation	2′ 0″	3′ 0″	4′ 0″	6′ 0″	8′ 0″	10′ 0″	12′ 0″	14′ 0″	16′ 0″
	Thickness of Concrete Foundation	6″	6″	9″	12″	15″	18″	21″	24″	27″
	Reference No. of B.R.C. Reinforcement (see p. 22)	12	7	6	3	5	3	1	3	2
	No. of Layers of B.R.C. Reinforcement	1	1	1	1	2	2	2	3	3
1½ Tons per sq. ft. on Ground	Width of Concrete .. Foundation	1′ 6″	2′ 0″	2′ 8″	4′ 0″	5′ 4″	6′ 8″	8′ 0″	9′ 4″	10′ 8″
	Thickness of Concrete Foundation	6″	6″	6″	9″	12″	15″	18″	21″	24″
	Reference No. of B.R.C. Reinforcement (see p. 22)	—	10	6	4	3	5	3	3	2
	No. of Layers of B.R.C. Reinforcement	—	1	1	1	1	2	2	2	2
2 Tons per sq. ft. on Ground	Width of Concrete Foundation	1′ 6″	1′ 6″	2′ 0″	3′ 0″	4′ 0″	5′ 0″	6′ 0″	7′ 0″	8′ 0″
	Thickness of Concrete Foundation	6″	6″	6″	9″	12″	15″	18″	21″	24″
	Reference No. of B.R.C. Reinforcement (see p. 22)	—	13	9	7	4	3	6	5	4
	No. of Layers of B.R.C. Reinforcement	—	1	1	1	1	1	2	2	2
3 Tons per sq. ft. on Ground	Width of Concrete Foundation	1′ 6″	1′ 6″	1′ 6″	2′ 0″	2′ 8″	3′ 4″	4′ 0″	4′ 8″	5′ 4″
	Thickness of Concrete Foundation	6″	6″	6″	6″	9″	12″	15″	18″	21″
	Reference No. of B.R.C. Reinforcement (see p. 22) .. .	—	—	13	9	6	5	4	4	3
	No. of Layers of B.R.C. Reinforcement	—	—	1	1	1	1	1	1	1

In the case of loads to the right of the heavy line, it is more economical to use piles, if a good foundation can be reached by the piles 20 feet or less below the surface of the ground.

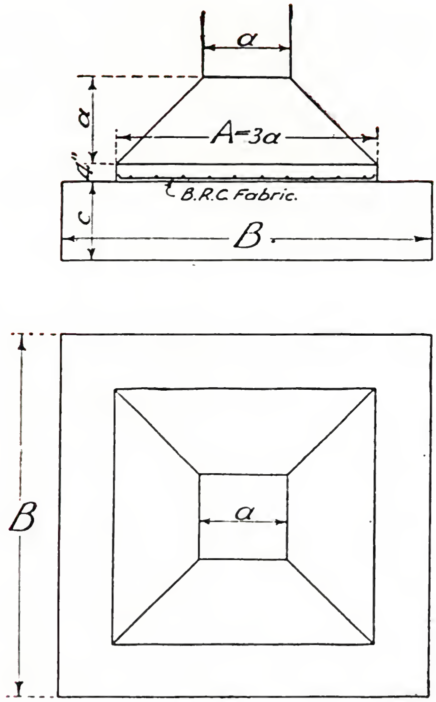


FIG. 18.

COLUMN FOUNDATIONS

Where the subsoil is unreliable, columns should be carried on B.R.C. Piles. Single Piles may be used for loads of 60 tons or less. For heavier loads, it is advisable to drive two or more piles close together, forming a group, the top of which may be made into a solid block by the addition of concrete after driving.

Where the subsoil is reliable, the foundations should be in the shape of a pyramid (Fig. 18) having sides sloping at 45 deg., with a square slab at the bottom where necessary to increase the spread of the load. The column bars should be run down into the pyramid straight for a distance of 6 inches along with their wrapping, and then bent outwards at 45 deg., without wrapping, for a distance equal to twenty times the diameter of the bar. The base of the pyramid should be reinforced with B.R.C. Fabric, Ref. 610, or other light Fabric.

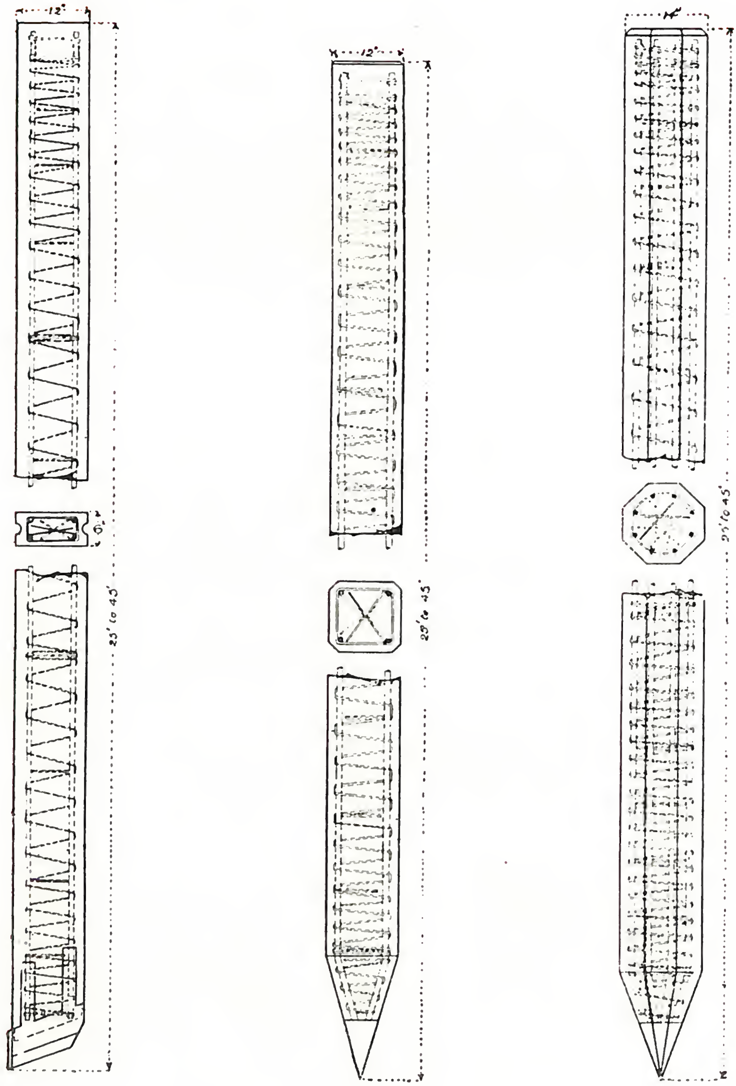
The dimensions of foundations for loads up to 200 tons, for allowable pressures on subsoil up to 4 tons per square foot, are given in the following table. Larger foundations may be designed for heavier loads.

TABLE 24

COLUMN FOUNDATIONS—Reinforced with light B.R.C. Fabric.

Allowable Pressure on Ground	Load on Column (Tons)	Approx. Size of Square Column (*a*)	Dimensions on Fig. 18		
			A	B	C
1 Ton per sq. ft.	15	10″	2′ 6″	4′ 0″	1′ 3″
	20	10″	2′ 6″	4′ 6″	1′ 6″
	30	12″	3′ 0″	5′ 6″	1′ 9″
	40	13″	3′ 3″	6′ 3″	2′ 0″
	50	14″	3′ 6″	7′ 0″	2′ 3″
	60	16″	4′ 0″	7′ 9″	2′ 6″
	80	18″	4′ 6″	9′ 0″	2′ 9″
	100	20″	5′ 0″	10′ 0″	3′ 0″
1½ Tons per sq. ft.	20	10″	2′ 6″	3′ 9″	1′ 0″
	30	12″	3′ 0″	4′ 6″	1′ 3″
	40	13″	3′ 3″	5′ 3″	1′ 6″
	50	14″	3′ 6″	5′ 9″	1′ 9″
	60	16″	4′ 0″	6′ 3″	1′ 9″
	80	18″	4′ 6″	7′ 3″	2′ 0″
	100	20″	5′ 0″	8′ 3″	2′ 0″
	130	22″	5′ 6″	9′ 3″	2′ 6″
	160	25″	6′ 3″	10′ 3″	2′ 6″
2 Tons per sq. ft.	20	10″	2′ 6″	3′ 3″	1′ 0″
	40	13″	3′ 3″	4′ 6″	1′ 3″
	60	16″	4′ 0″	5′ 6″	1′ 3″
	80	18″	4′ 6″	6′ 3″	1′ 6″
	100	20″	5′ 0″	7′ 0″	1′ 6″
	130	22″	5′ 6″	8′ 0″	1′ 9″
	160	25″	6′ 3″	9′ 0″	2′ 0″
3 Tons per sq. ft.	20	10″	2′ 6″	2′ 9″	9″
	40	13″	3′ 3″	3′ 9″	9″
	60	16″	4′ 0″	4′ 6″	9″
	80	18″	4′ 6″	5′ 3″	1′ 0″
	100	20″	5′ 0″	5′ 9″	1′ 0″
	130	22″	5′ 6″	6′ 9″	1′ 0″
	160	25″	6′ 3″	7′ 3″	1′ 0″
	200	28″	7′ 0″	8′ 3″	1′ 3″
4 Tons per sq ft.	40	13″	3′ 3″	—	—
	60	15″	4′ 0″	—	—
	80	18″	4′ 6″	—	—
	100	20″	5′ 0″	—	—
	130	22″	5′ 6″	5′ 9″	9″
	160	25″	6′ 3″	6′ 3″	9″
	200	28″	7′ 0″	7′ 0″	9″

STANDARD B.R.C. PILES.



SHEET PILE.

SQUARE PILE.
To take 40 tons.

OCTAGONAL PILE.
To take 60 tons.

Fig. 19.

PILES.

The advantages of Reinforced Concrete Piles are so numerous and so considerable as to make them in all cases preferable to piles of steel, iron or timber.

They are not affected by any of the elements which play such havoc with piles made of other materials.

If the depth to which they require to be driven is less or greater than anticipated, they can be cut short or lengthened to suit the case, after driving has commenced.

The tops of B.R.C. Piles are in no way damaged by being driven.

The cost is generally less than that of other forms of piles.

Fig. 19 shows types of our Standard Square and Octagonal Piles and also our Sheet Piles. They are formed of rods encircled with B.R.C. Sectionised Helical Wrappings, having also B.R.C. Hoops at the top and at various intervals along the shaft. They are made from 25 to 45 feet long.

The Square Pile is 12 inches square, and is suitable for any load up to 40 tons.

The Octagonal Pile is 14 inches across the flats, and is suitable for any load up to 60 tons. Corresponding Piles 14 inches square are also made.

The Sheet Pile is rectangular, 12 inches by 6 inches, with a groove down each side. The groove on a driven pile is cleaned out by a projection on the shoe of the following pile, and is then grouted in to bind the piles together.

All Piles are fitted with Cast Iron or Steel Shoes.

Piles of various lengths and sections can be made without difficulty to suit special requirements, but the above sizes are most commonly used. They can be grouped to take nearly all practical cases of loading. They are frequently used to carry walls, being placed at convenient distances apart, with a sill formed on top.

They can be continued above ground to form piers for reinforced brick panels.

We recently supplied piles 35 feet long, arranged for calculated concentrated loads of 416 tons.

They are excellently adapted to Pier, Wharf, or Dock construction, and can be readily framed and braced above ground or water level where necessary.

Piles constructed with our B.R.C. reinforcements are stronger than any other form of reinforced concrete pile.

Although our standard piles are constructed to carry from 20 to 60 tons, the safe load on any pile depends on the holding power of the ground, which is dependent on the amount of driving.

$$\text{Safe Load on Pile (tons)} = \frac{W^2h}{d(W + P)} \div \text{Factor of Safety.}$$

Where W = weight of ram (tons).
h = height of fall (inches).
P = weight of pile (tons).
d = average penetration of last few blows (inches).

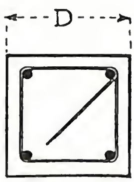
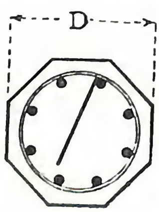
The Factor of Safety varies from 3 to 8, according to the nature of the load which the pile is intended to support

When driving reinforced concrete piles, it is advisable to use a heavy ram with a small fall, and to use a wooden dolly.

Some care must be taken in the case of long piles to avoid subjecting them to excessive bending stress while handling them during transport or slinging them into position.

TABLE 25

PILES—reinforced with Round Steel Bars and B.R.C. Hoops or Wrappings.

Ref. No.	Type	D. ins.	Reinforcement	Safe Loads (tons)
P 41		12	Round	20
P 42			steel bars	25
P 43			with	30
P 44			B.R.C. Hoops	35
P 45			and	40
			Helical	
			Wrappings	
P 81		14	varied in	40
P 82			accordance	45
P 83			with the	50
P 84			required	55
P 85			Safe Load	60

Piles, 14 inches square, corresponding with the 14 inch octagonal, are also used.

FLOORS ON GROUND.

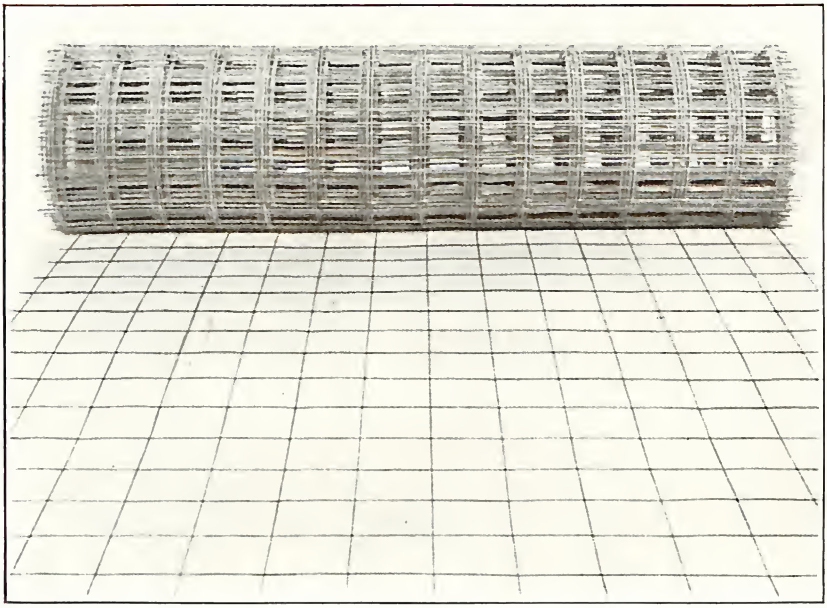


Fig. 20.

Two special sizes of B.R.C. Fabric are made for use in all classes of concrete floors or pavements laid directly on the ground, such as Office and Warehouse Basements, Workshop and Shed Floors, Platforms, Slopes and Embankments, Garages and Yards, Promenades and Footpaths.

Such floors laid without B.R.C. Fabric almost invariably crack, especially if laid on filling. Cracking may be due to contraction, expansion, unequal settlement, or unequal loading. If the floor is finished with a surface of granolithic, mosaic, asphalte, wood block, stone setts, or other form of paving, the cracking extends to such surface. In some cases it causes serious trouble; in all cases it is unsightly and objectionable. The liability to crack is considerably reduced, and in most cases cracking is entirely eliminated by using a layer of B.R.C. Fabric in the concrete.

At the same time the thickness of concrete may be reduced and the floor be more quickly laid; a thickness of 3 ins. or 4 ins. of concrete is generally sufficient, but more may be required on soft ground. B.R.C. Fabric Ref. No. 655 (see p. 28) is recommended where the floor is built

on top of filling or where the loads are heavy, and Ref. No. 610 (see p. 28) where there is no filling and the subsoil is firm or where the loads are light.

The saving in the cost of concrete owing to the reduction that may be made in the thickness is more than the cost of the B.R.C. Fabric. By use of B.R.C. Fabric the strength of the floor is increased, the cost of construction reduced, and time is saved in the execution of the work.

Road Reinforcements

BRC Fabric

ROAD REINFORCEMENT.

Road Foundations. Asphalte, Wood Block, Stone Sett, and similar road surfaces are laid on beds of concrete of 6 ins. or greater thickness.

If there are weak spots in the ground below, or even on good ground if the traffic is very heavy, the concrete in course of time cracks or sags, and hollows form in the road surface above. The expense of repairing such hollows is a heavy item in the cost of road maintenance, and repaired hollows soon become faulty again.

B.R.C. Fabric has been largely used, and with very great success, to strengthen the concrete and prevent the occurrence of these hollows. A layer of Fabric is placed in the concrete, reinforcing it to such an extent that it is strong enough to bridge over the weak spots. The Fabric, being supplied in rolls 240 ft. long and 7 ft. wide, is very easy to lay.

The strength of Fabric to use depends upon the nature of the ground and the nature of the traffic to which the road is subject. The cost of Fabric is small proportionately to the cost of the road and is partly balanced by the reduced thickness of concrete, but independently of this is quickly repaid in reduced cost of road maintenance.

For the heaviest traffic it is generally sufficient to have a thickness of 6 in. of concrete reinforced with No. 9 B.R.C. Fabric. The fabric is laid about 2 in. above the bottom of the concrete. If the ground is poor, 7 in. of concrete should be used.

For lighter traffic the thickness of concrete may be reduced to 5 in. with a lighter gauge of reinforcement, No. 11 or No. 14 Fabric, depending on the class of traffic, and the nature of the ground.

In view of the changing nature of traffic, it is in most cases advisable to anticipate the advent of heavier vehicles by using 6 in. concrete with No. 9 Fabric.

B.R.C. Fabric in a road-bed presents no obstacle to trench cutting. The steel wires are of great tensile strength, a necessity for their purpose; they are, however, comparatively thin, and may be cut through quite easily with any light trenching tool, or snipped with wire cutters.

The concrete may be broken away from B.R.C. Fabric by means of the usual road-breaking tools. But when laid in the road-bed, owing to

the large mesh of the Fabric, and the perfect union at the welded connections, no amount of vibration or hammering from road traffic can cause dissociation between the reinforcement and the concrete, or prevent the two materials from acting together as one structural unit.

In relaying a trench top, a series of suitably sized sheets of B.R.C. Fabric, laid transversely, transform it into a unit structurally sound, so that the wearing surface is sustained without subsidence and the pipes below are protected from fracture.

A great deal of improvement in existing road-beds may be effected by using B.R.C. Fabric in the reinstatement of trench tops, even where the whole road-bed is not reinforced. B.R.C. Fabric is frequently used in this way.

B.R.C. Fabric provides a perfect road foundation even on weak ground, making it as serviceable as the consolidated foundation of the oldest road, because it spreads each wheel load over a very large area of the under-bed.

B.R.C. Fabric has been used with most successful results in tramway foundations, being laid in sheets in the concrete foundation transversely to the rails, No. 9 Fabric being used with concrete from 6 in. to 9 in. thick.

With the foundation reinforced in this way, the setts maintain an even surface level with the rails, and there is an entire absence of the inequalities which are otherwise a frequent source of trouble and inconvenience.

Reinforced Concrete Road Surfaces. Much attention is now directed to the use of complete reinforced concrete roads, in which the concrete forms both foundation and surface. Some years ago there was a lack of success in concrete road trials, probably owing to the poor quality of concrete used. More recently, such roads have been extensively adopted in the United States, with very great success, and millions of yards are now laid annually. They have also been proved by experience in England to be exactly suitable for light and medium traffic, such as that of suburban side streets, and for secondary roads. The advantages are freedom from dust in summer and from mud in winter, absence of side slip, ease of scavenging, economy in first cost, and reduction of maintenance charges. The cost of maintenance is about one-fifth of a penny per square yard per annum.

We recommend the use of a surfacing of tar spray and granite chips on top of the concrete, renewed every second or third year, or as other-

wise required. This adds to the cost of maintenance, but increases the efficiency of the road, and provides for occasional heavy traffic.

Care must be taken to observe certain important points in the construction of such roads, and we issue a special specification for the purpose.

B.R.C.
Road
Specifications

SPECIFICATION FOR REINFORCED CONCRETE ROAD FOUNDATION

Reinforced Concrete Road Foundations are constructed to be surfaced with stone setts, woodblock, asphalte or macadam.

The concrete should generally be 6 in. thick, reinforced with No. 9 B.R.C. Fabric, laid either longitudinally or transversely (preferably longitudinally) 1 in. to 2 in. above the bottom of the concrete.

> This construction will spread any wheel load over an area of at least 10 sq. ft. of ground. Standard rolls of fabric are 240 ft. long by 7 ft. wide.

The side slope of the surface of concrete should be the same as required for the finished surface of road, the surfacing being laid of even thickness throughout.

The ground to receive the foundation should be graded to the shape of the road surface. It may, if more convenient, be laid flat, but this requires more concrete.

Where filling is necessary, the ground should be filled in layers not more than 1 ft. thick, each layer wetted and well rammed or rolled with a light roller.

> If a steam roller is used it need not be more than a 5-ton machine, but a horse roller or heavy hand roller is often sufficient, and will give sufficient consolidation because, owing to the greatly increased spread given by the r.c. foundation, the load on the ground is much less than with other foundations.

The concrete should consist of four parts coarse aggregate, two parts fine aggregate, and one part cement, all measured by volume. It should not be mixed sloppy, but to a quaky consistency, and to produce this result the ratio of volume of water to volume of cement may be from 30 per cent. to 70 per cent., depending on the nature of the aggregate and its state of dryness. The coarse aggregate should be good, hard broken stone from $1\frac{1}{2}$ in. to $\frac{1}{4}$ in. The fine aggregate should be from $\frac{1}{4}$ in. down to fine sand. Gravel may be used, combining coarse and fine aggregate, and the proportion of cement should be one part to four parts mixed gravel.

> Tests for voids should always be made; the voids will generally be from 40 per cent. to 50 per cent. of the volume of coarse aggregate and of fine aggregate, each taken separately, or from 20 per cent. to 25 per cent. of the mixed gravel. Both stone and sand must be quite clean.

The surface of the concrete need not be finished smooth unless stone setts or wood blocks are to be laid on top. If macadam is to be laid on top, the surface should be purposely made rough to give the best possible key.

The surfacing should be laid directly on top of the concrete without sand or other intermediate material.

It is important to soak the ground before laying the concrete, so that the water required to enable the concrete to set properly may not be drawn away.

The concrete should be left from one to two weeks before laying the surfacing material on it, and a further one or two weeks should elapse before the road is opened to traffic.

SPECIFICATION FOR COMPLETE REINFORCED CONCRETE ROAD

The concrete should be generally 6 in. thick, reinforced with No. 9 B.R.C. Fabric laid longitudinally from 1 in. to 2 in. above the bottom of the concrete.

This construction will spread any wheel load over an area of at least 10 sq. ft. of ground. Standard rolls of fabric are 240 ft. long by 7 ft. wide. Fabric lighter than No. 9 should not be used even if the concrete is more than 6 in. thick. The fabric is required to distribute the contraction stresses in the concrete, and No. 9 is the correct size for concrete 6 in. thick. If the concrete is thicker, heavier reinforcement is advisable. The fabric is required just as much for distributing contraction stresses as it is for strengthening the concrete to carry the load of the traffic.

The side slope should be 1 in 50. This is to allow the water to run off and to prevent it from lodging in any slight inequalities in the surface. It is not required for any other purpose.

A side slope of 1 in 50 gives an agreeable running surface without danger of side-slip for horses. As it is agreeable to run on, there is no incentive for traffic to seek the crown of the road.

The ground to receive the concrete should be graded to the shape of the finished road surface. It may, if more convenient, be laid flat, but there is no advantage as far as efficiency is concerned, and it requires more concrete.

Where filling is necessary the ground should be filled in layers of not more than 1 ft. thick, each layer wetted and well rammed or rolled with a light roller.

Filling in layers of about 6 in. gives the best results. If a steam roller is used it need not be more than a 5-ton machine, but a horse roller or hand roller will often give sufficient consolidation, because owing to the reinforced construction the spread of the load on the ground is greater and the pressure much less than with other roads.

Drainage is of the utmost importance. It should be obtained through side ditches, which may be left open, or, tiled and filled up with rubble. The ditches should be at least 18 in. deep. Streets in towns are drained in the ordinary way.

The concrete should consist of three parts coarse aggregate, $1\frac{1}{2}$ parts fine aggregate, and 1 part cement, all measured by volume. The coarse aggregate should be broken stone from $1\frac{1}{2}$ in. to $\frac{1}{4}$ in. The stone must be good hard stone. The fine aggregate should be from $\frac{1}{4}$ in. down to fine sand.

> These proportions are based on material with about 40 per cent. voids. Tests for voids should always be made, and if voids are more than 40 per cent. the proportions of aggregate and cement should be varied accordingly. Both stone and sand must be quite clean.

Gravel is not generally recommended for surface work. If used, it should be free from flints, and the top $1\frac{1}{2}$ in. of the concrete should have the gravel crushed to pass through a $\frac{3}{8}$ in. mesh. This $1\frac{1}{2}$ in. topping should be laid immediately (not more than twenty minutes) after the lower part is laid, and before it has begun to set. Similarly with a granite concrete topping where such is used.

> The voids in mixed gravel should not exceed 25 per cent. A granite concrete topping $1\frac{1}{2}$ in. thick forms an excellent surface for any concrete road, but there is no need for it if the concrete generally is made with a good hard stone aggregate.

Transverse joints in the road surface are a source of weakness, and are not required. Where work is left overnight it should be finished with a straight vertical edge across the road, and an extra strip of reinforcement 3 ft. wide should be inserted about 2 in. below the top of the concrete, half the width (*i.e.*, 18 in.) being built into the day's work, leaving 18 in. projecting to bond into the next day's work.

Where a road is laid in two halves (to leave one side open for traffic) the longitudinal joint along the middle of the road should be finished against a board with a straight vertical edge, without any reinforcement projecting. The concrete must be well worked against the board to give a good dense material. The second half of the road should be finished tight up against the first half. If the edge of the first half is at all friable it should be cut back for about 1 in., or so far as the weak edge extends, and about 2 in. down, and the concrete of the second half must then be well rammed against it.

An alternative method is to finish the edge of each half with a row of stone setts making the concrete 6 in. thick below the setts, and for a 12 in. width adjoining them. The setts should be laid while the concrete is wet and grouted with fine concrete.

It is important to thoroughly soak the ground before laying the concrete, so that the water required to enable it to set properly may not be drawn away.

The concrete should be mixed as dry as possible so long as a workable mixture is obtained.

> To give the correct consistency the ratio of volume of water to volume of cement may be from 30 per cent. to 70 per cent. depending on the nature of the aggregate and its state of dryness. It should be borne in mind that any excess of water decreases the strength of the concrete, and if there is much excess this decrease in strength is considerable.

The surface of the concrete should be struck off by a wooden template the full width of the road, worked by a man at each side of the road. It should then be finished from a bridge across the road with a wooden float.

> A metal float must not be used. It is a mistake to obtain a smooth, plaster-like finish. Such finish brings fine material to the top which will flake off under traffic.

It is an advantage to squeeze the excess water out of the concrete by rolling the surface from side to side of the road with a hollow roller about 5 ft. long by 8 in. diameter, made from sheet steel, weight about 80 lbs., and follow up with a rubber or canvas belt about 8 in. wide worked by a man at each side of the road and drawn across the surface of the concrete with a slight forward motion. This gives a gritty surface.

The concrete should be left overnight covered with tarpaulin or with canvas on wooden frames, and next day be covered with about 2 in. of sand or loam, which should be kept wet for a fortnight to cause the concrete to harden thoroughly.

> This is absolutely essential to secure a good wearing surface. The same result may be obtained by "ponding," *i.e.*, building low earth dams along the sides and at regular intervals across the road, and filling up with water, allowing the water to stand a fortnight.

The road should be left at least three weeks before it is opened to traffic. In damp weather a longer time may be required. The surface should be covered with a coating of tar spray and granite chips.

> It is preferable to apply this coating in two thin layers. The road may be opened to traffic and used for a month before tarring, but should be well swept with a stiff broom before the tar is applied.

SPECIFICATION FOR REINFORCED CONCRETE FOOTPATH

The concrete should be 2 in. thick reinforced with No. 14 B.R.C. Fabric, laid either longitudinally or transversely $\frac{1}{2}$ in. below the top of the concrete.

Standard rolls of fabric are 240 ft. long by 7 ft. wide.

The ground to receive the concrete should be graded to the shape of the finished footpath.

Where filling is necessary the ground should be filled in layers of not more than 1 ft. thick, each layer wetted and rammed or rolled with a hand roller.

The concrete should consist of 3 parts coarse aggregate, $1\frac{1}{2}$ parts fine aggregate and 1 part cement, all measured by volume. The coarse aggregate should be good hard broken stone from $\frac{3}{4}$ to $\frac{1}{8}$ in. The fine aggregate should be from $\frac{1}{8}$ in. down to fine sand.

Both stone and sand must be quite clean.

Gravel is not generally recommended. If used, it should be free from flints.

The concrete should be laid in sections about 30 ft. long, with joints $\frac{1}{4}$ in. wide between sections. The joints should be filled with asphalte, or similar pliable material.

The ground should be soaked before laying the concrete, so that the water required to enable it to set properly may not be drawn away. The concrete should be mixed as dry as possible so long as a workable mixture is obtained.

> To give the correct consistency, the ratio of volume of cement may be from 30 per cent. to 70 per cent., depending on the nature of the aggregate and its state of dryness.

The surface of the concrete should be struck off by a wooden template the width of the footpath, and should be finished if necessary with a wooden float.

> A metal float must not be used. It is a mistake to obtain a smooth, plaster-like finish. Such finish brings fine material to the top which will flake off under traffic.

The concrete should be left overnight covered with tarpaulin or other protection, and next day be covered with about 2 in. of sand or loam, which should be kept wet for a fortnight to cause the concrete to harden thoroughly. This is essential to obtain a hard wearing surface.

The footpath should be left two weeks before it is opened for use. In damp weather a longer time may be required.

SPECIFICATION FOR REINFORCED BITUMINOUS MACADAM ROAD.

The existing road surface should be scarified to a depth of 3 inches with a steam roller, any weak places to be opened up, packed with spalls, and all consolidated to proper grades. Spread over the whole a uniform coating of clean two-inch metal rolled and consolidated to a full three-inch thickness. The whole surface is then to be sprayed with Bitumen at 350 deg. Fah. at the rate of $\frac{3}{4}$ gallon per square yard.

Lay on this surface B.R.C. Fabric No. 636. Fabric to be rolled out longitudinally along the road and held in position by means of spikes into the metal below at intervals such as may be necessary to hold fabric firmly in position. Over the fabric spread top coat of 2 inch metal thoroughly consolidated by steam rolling to a further three inches finished thickness, and penetrate with Bitumen at 350 deg. Fah. as before, $\frac{3}{4}$ gallon per square yard.

Sprinkle surface of road with $\frac{1}{2}$ inch clean stone chippings, and further consolidate by rolling until a clean, even surface results. Seal next with Bitumen at 350 deg. Fah., spreading same over the surface and rubbing in with squeeges at an average of $\frac{1}{2}$ gallon per square yard. Lightly sprinkle with $\frac{1}{8}$ in. clean screenings, and finally roll and sweep surface.

TANKS, RESERVOIRS, BATHS.

Tanks, reservoirs, swimming baths, and the like, are more cheaply and efficiently constructed in reinforced concrete than in steel, iron, timber, brick, masonry, or any other material.

Even with a construction of segmental steel or cast iron it has been found difficult to obtain a perfectly water-tight tank, and some reinforced concrete tanks have developed leaks through being imperfectly designed as regards resistance to stresses due to change of temperature.

The success of B.R.C. structures is due to the rigidity of our system and the manner in which, owing to the design of our reinforcements, resistance is provided against stresses in all directions.

It is preferable, where possible, to have tanks circular in shape, and, if the tops are to be covered in, a dome-shaped roof is the most economical.

BUNKERS

SILOS

BRIDGES

RETAINING WALLS

PIERS

CULVERTS

SEWERS

WATER MAINS

STAIRCASES

PONTOONS

BARGES

B.R.C. reinforcements have been successfully applied to each of the above and to many other types of construction.

The structures consist generally of columns, beams, and slabs combined in different ways, and the sizes of the various members can in most cases be derived from the respective tables.

REINFORCED BRICKWORK.

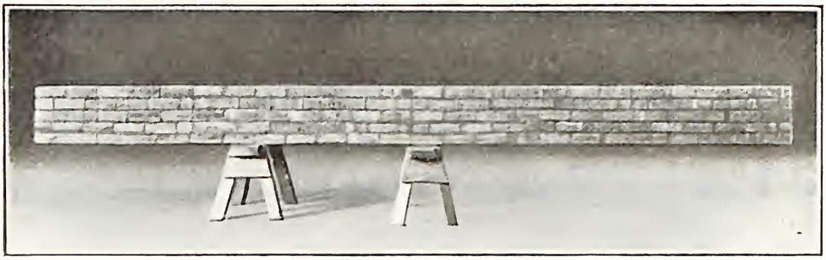


FIG. 21.

FIG. 22.

Reinforced Brickwork is in reality a form of reinforced concrete in which the irregular stone aggregate is replaced by regular-shaped aggregate in the form of bricks. It is less allied to ordinary brickwork than it is to reinforced concrete, and its strength can be calculated in the same way as that of the latter. The difference in strength between plain brickwork and reinforced brickwork is as great as, if not greater than, that between plain and reinforced concrete, and it is questionable whether local bye-laws and regulations applying to plain brickwork can be held to apply to reinforced brickwork without considering the height or length of the brick panel to be the height or length between the successive units of reinforcement, and taking this view the advantages and economies that accrue from the use of reinforced brickwork may be utilised without unreasonable restriction.

A reinforced brick wall will withstand horizontal pressure from either side, such as that of the wind or of material piled against the wall and will also, acting as a vertical beam, carry its own weight from pier to pier, or between other similar supports, spaced as far apart as 30 feet or more, without intermediate support, and will in addition transmit other superimposed loads to such supports.

The accompanying photographs show tests of a $4\frac{1}{2}$ in. brick panel reinforced with B.R.C. Fabric in the mortar joints. The panel consists of five courses. In one view (Fig. 21) it is shown as a vertical cantilever carrying its own weight projecting rather more than 8 feet beyond the nearest support, and in the other view (Fig. 22) it is turned over on its side and tested as a slab, carrying a superimposed load, in addition to its own weight, of 16 cwt. between supports 7 feet apart. The ordinary forms of hollow floors frequently used for large spans, constructed of hollow brick blocks with narrow strips of reinforced concrete between, are types of reinforced brickwork, and such have been extensively adopted to carry both light and heavy loads.

In localities where bricks are readily obtainable at a reasonable price reinforced brickwork is a more economical and a more quickly built form of construction for panel walls than reinforced concrete. It is particularly suitable for the walls of works buildings where it can be built to fill in the space between timber, steel, or reinforced concrete columns. For panels up to 20 feet long the brickwork may be $4\frac{1}{2}$ in. thick; its ends may rest on the column foundations and no foundation is required in between; it is stronger than a plain brick wall 14 in. thick. A 9 in. reinforced wall is similarly suitable for panels up to 30 feet long.

For boundary walls reinforced brickwork panels $4\frac{1}{2}$ in. thick may be used between buttresses 20 feet apart, the buttresses consisting of brick piers, steel joists, or reinforced concrete uprights; the ends of the panels rest on the buttress foundations and no intermediate foundation is required.

For partition walls of works, factories, warehouses, offices, and dwellings reinforced brickwork $4\frac{1}{2}$ in. thick is stronger than unreinforced walls 9 in. thick, and should always be used except where greater thickness is required for sound-proofing purposes.

For exterior walls of these buildings 9 in. plain brickwork is sometimes used, but is not weatherproof; $4\frac{1}{2}$ in. reinforced brickwork may be made quite weatherproof by painting with colourless waterproofing paint, and as the walls do not settle or crack and the mortar, being cement mortar, does not perish, the waterproofing remains permanent. For greater protection against outside temperature conditions 9 in. reinforced brickwork should generally be used.

In substituting reinforced brickwork for plain brickwork it should be borne in mind that a sufficient area of brickwork must be provided to carry the compressive loads such as might be transmitted to the walls from

floors resting on them—although such cases are hardly likely to arise in connection with panel walls and partition walls, and the point is generally negligible.

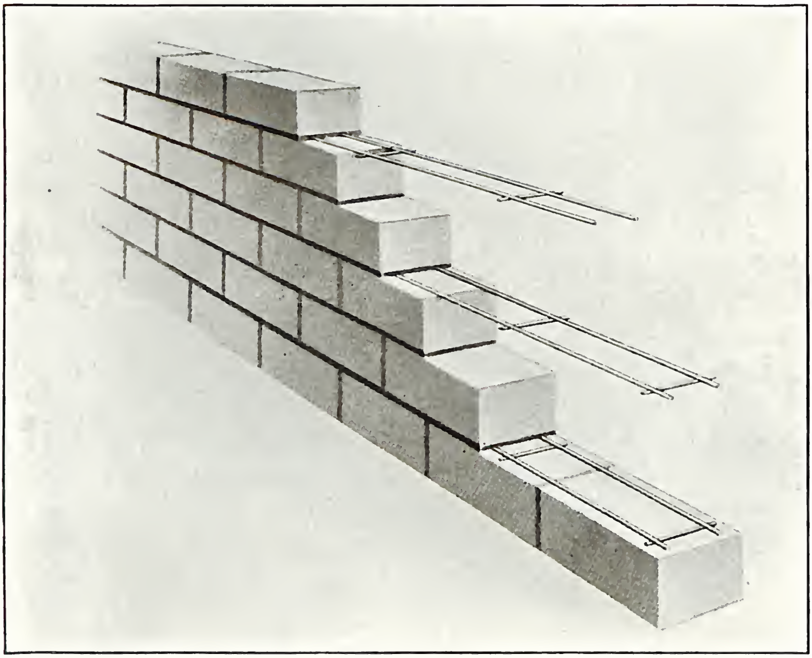


Fig. 23.

B.R.C. Brick Wall Reinforcement consists of steel wire mesh made from oval wires. The advantage of the oval wire is that it lies flat and does not take up much room, so that a heavier section of wire can be used without having to increase the thickness of the mortar joint. Wire equivalent in section to No. 9 or No. 10 gauge round is used.

For 4½ in. walls the mesh consists of two strands of wire 3 in. apart, with cross wires welded to them at intervals of 12 in.; the cross wires are 3½ in. long.

For 9 in. walls the mesh consists of two strands of wire 6 in. apart, with cross wires at intervals of 12 in.; the cross wires are 6½ in. long.

There is no advantage whatever in having more than two strands of wire, either for a 4½ in. or a 9 in. wall, as the object is to get the reinforcing wire as close as possible to the face of the wall, where it performs its best duty.

The walls should be built with cement mortar, and the reinforcement is put in every fourth, third, or second course, or every course, depending on the length of the wall, and whether it is an outside wall or a partition wall.

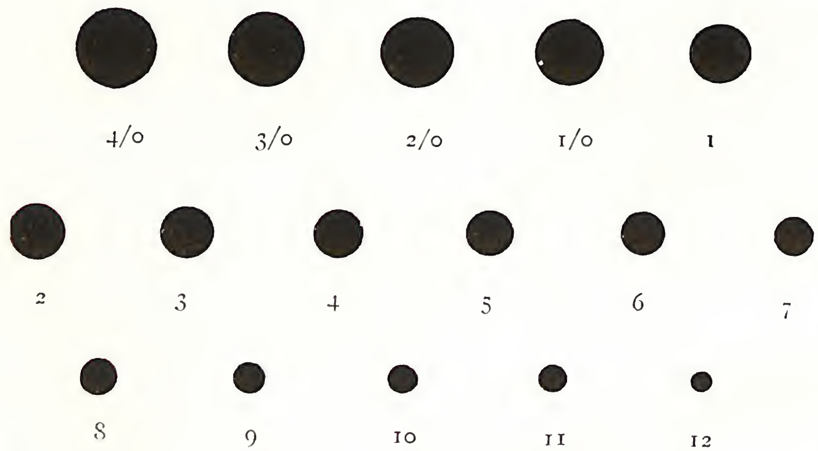
The reinforcement is stocked in rolls 25 yards long.

Reference No.	Thickness of Wall	Width of Fabric	Length of Roll	Shipping Dimensions	
				Width of Roll	Diam. of Roll
	Inches	Inches	Yards	Inches	Inches
B1	$4\frac{1}{2}$	$3\frac{1}{2}$	25	$4\frac{1}{2}$	14
B2	9	$6\frac{1}{2}$	25	$7\frac{1}{2}$	14

PROPERTIES OF OUR STEEL WIRE.

Tensile Strength— Minimum—80,000 lbs. per sq. inch.
(= 35.7 tons per sq. inch.)

Full Size Sections—



Imp'l stand'd wire gauge	Diam. (ins.)	Area of cross section (sq. ins.)	Weight per 100 ft. len. (lbs.)	Minimum Tensile strength (breaking) (lbs.)	Area of cross section (sq. ins.) per ft. width if wires are spaced at 2″ cent.	3″ cent.	4″ cent.	6″ cent.
4/0	.400	.1257	42.69	10052	.7542	.5028	.3771	.2514
3/0	.372	.1087	36.93	8694	.6522	.4348	.3261	.2172
2/0	.348	.0951	32.31	7608	.5706	.3804	.2853	.1902
1/0	.324	.0824	28.01	6595	.4944	.3296	.2472	.1648
1	.300	.0707	24.01	5655	.4242	.2828	.2121	.1414
2	.276	.0598	20.32	4785	.3588	.2392	.1794	.1196
3	.252	.0499	16.95	3990	.2994	.1996	.1497	.0998
4	.232	.0423	14.36	3381	.2538	.1692	.1269	.0846
5	.212	.0353	11.99	2824	.2118	.1412	.1059	.0706
6	.192	.0290	9.81	2316	.1740	.1160	.0870	.0580
7	.176	.0243	8.26	1946	.1458	.0972	.0729	.0486
8	.160	.0201	6.82	1608	.1206	.0804	.0603	.0402
9	.144	.0163	5.53	1303	.0978	.0652	.0489	.0326
10	.128	.0129	4.37	1030	.0774	.0516	.0387	.0258
11	.116	.0106	3.60	845	.0636	.0424	.0318	.0212
12	.104	.0085	2.88	689	.0510	.0340	.0255	.0170

PROPERTIES OF ROUND AND SQUARE STEEL BARS.

Tensile Strength of Steel—64,000 lbs. per sq. inch. (=28.57 tons per sq. inch).

Diam. or length of side (ins.)	Round Bars: Area of cross section (sq. ins.)	Round Bars: Weight per ft. length (lbs.)	Round Bars: Tensile (break'g) strength (lbs.)	Square Bars: Area of cross section (sq. ins.)	Square Bars: Weight per ft. length (lbs.)	Square Bars: Tensile (break'g) strength (lbs.)	Length of side or Diam. (ins.)
$\frac{1}{4}$	0.049	0.167	3100	0.063	0.213	4000	$\frac{1}{4}$
$\frac{5}{16}$	0.077	0.261	4900	0.098	0.332	6300	$\frac{5}{16}$
$\frac{3}{8}$	0.110	0.376	7060	0.141	0.478	9000	$\frac{3}{8}$
$\frac{7}{16}$	0.150	0.511	9600	0.191	0.651	12200	$\frac{7}{16}$
$\frac{1}{2}$	0.196	0.668	12500	0.250	0.849	16000	$\frac{1}{2}$
$\frac{9}{16}$	0.249	0.845	15900	0.316	1.076	20200	$\frac{9}{16}$
$\frac{5}{8}$	0.307	1.043	19600	0.391	1.328	25000	$\frac{5}{8}$
$\frac{11}{16}$	0.371	1.262	23700	0.473	1.607	30300	$\frac{11}{16}$
$\frac{3}{4}$	0.442	1.502	28300	0.563	1.912	36000	$\frac{3}{4}$
$\frac{13}{16}$	0.519	1.763	33200	0.660	2.245	42200	$\frac{13}{16}$
$\frac{7}{8}$	0.601	2.044	38500	0.766	2.603	49000	$\frac{7}{8}$
$\frac{15}{16}$	0.690	2.347	44200	0.879	2.988	56300	$\frac{15}{16}$
1	0.785	2.670	50200	1.000	3.400	64000	1
$1\frac{1}{8}$	0.994	3.380	63600	1.266	4.403	81000	$1\frac{1}{8}$
$1\frac{1}{4}$	1.227	4.172	78500	1.563	5.312	100000	$1\frac{1}{4}$
$1\frac{3}{8}$	1.485	5.049	95000	1.891	6.428	121000	$1\frac{3}{8}$
$1\frac{1}{2}$	1.767	6.008	113100	2.250	7.650	144000	$1\frac{1}{2}$
$1\frac{5}{8}$	2.074	7.051	132700	2.641	8.978	169000	$1\frac{5}{8}$
$1\frac{3}{4}$	2.405	8.178	153900	3.063	10.412	196000	$1\frac{3}{4}$
$1\frac{7}{8}$	2.761	9.388	176700	3.516	11.953	225000	$1\frac{7}{8}$
2	3.142	10.681	201100	4.000	13.600	256000	2

Concrete

BRC
Fabric

CONCRETE.

Concrete is made of cement, sand, and aggregate mixed wet, and allowed to set. The setting is partly a physical and partly a chemical action.

The aggregate used may be of almost any hard, clean material, such as granite, stone, gravel, broken brick, or burnt ballast. If a quantity of any of these aggregates be thrown in a heap at random it will be found to contain voids, or empty spaces, varying from 20 per cent. to 60 per cent. of its volume. The usual percentage is from 40 to 50. In the mixing of concrete these voids are more or less filled by sand, but the sand itself contains voids which, although small, commonly amount to from 35 to 40 per cent. of the volume of the sand. These voids are filled by the cement, which, in setting, binds the whole mass solidly together.

The solidity of the mass depends upon the proportions and mixing of the materials. In certain classes of ordinary (not reinforced) concrete work it is not essential to have an absolutely solid mass, and the proportion of cement may be as small as 1 to 4 of sand and 8 of aggregate. Concrete for use in Reinforced work should always be proportioned so that the sand and cement are respectively in excess of the voids in the aggregate and sand. This can in general be obtained by mixing 4 of aggregate, 2 of sand, 1 of cement, *i.e.,* 4 cubic yards of aggregate, 2 cubic yards of sand, and 1 cubic yard (or 22 cwt.) of cement. The proportion of cement should never be less than this.

For tanks and similar work which must be absolutely waterproof, the amount of cement should be increased to 26 cwt. As the sand and cement mostly go to fill the voids in the aggregate, the quantity of concrete obtained from the above is only 4 1-3rd cubic yards, which is very little more than the volume of the aggregate alone.

The correct proportions for mixing can always be found by measuring the voids in the aggregate, and in the sand. This is done by filling aggregate or sand into a vessel of known volume and measuring the amount of water that can be added before overflowing. The sand or aggregate should be damped (*i.e.,* it should be wet and the water allowed to run off) before placing in the vessel. The cement should be so proportioned as to be 10 per cent. in excess of the voids in the sand; the sand and

cement together form a paste, and this should be 10 per cent. in excess of the voids in the aggregate.

Aggregate. The best materials are granite, stone, gravel, brick, and burnt ballast.

Granite forms the strongest concrete, but is rather expensive.

Stone, gravel (or ballast), or brick is generally used. Stone and gravel are not as good as brick for fire resistance, but are stronger.

Coke breeze, pan breeze, or boiler ashes should not be used.

The aggregate should be clean and of a cube-like nature (not in flakes), varied in size as much as possible between ½ in. and ¾ in. Material which passes a sieve of ¼ in. mesh should be separated by screening before the materials are measured, and should be reckoned as sand.

Sand. The sand should be clean, sharp, and gritty, free from ligneous, organic, earthy, or other impurities. It should be composed of various sizes up to particles which will pass a ¼ in. square mesh, but at least 75 per cent. should pass a ⅛ in. square mesh. It should be such that it does not require washing, as the finer particles are lost thereby.

Cement. Slow setting Portland Cement, complying with the requirements of the specification adopted by the British Engineering Standards Committee, should be used. It should be from an approved manufacturer, whose name should be upon each bag.

Each consignment should be tested for specific gravity, tensile, strength, fineness of grinding, soundness, and time of setting. The two latter tests should be frequently made from each consignment during the progress of the work.

The following is an extract from the British Engineering Standards Committee's Specification for Portland Cement:—

Specific Gravity.

Not less than 3.10 (after delivery).

Tensile Strength.

Cement— 7 days from gauging—400 lbs. per sq. in.
28 „ „ 500 lbs. „ „

Sand and Cement (3 sand and 1 cement by weight)—
7 days from gauging—120 lbs. per sq. in.
28 „ „ 225 lbs. „ „

Fineness of Grinding.

Residue on 76 × 76 mesh to the sq. in. sieve not to exceed 3 per cent.

Residue on 180 × 180 mesh to the sq. in. sieve not to exceed $22\frac{1}{2}$ per cent.

Soundness.

The cement shall be tested by the Le Chatelier method.

The apparatus for conducting the Le Chatelier Test consists of a small split cylinder of spring brass or other suitable metal of 0.5 millimetre (.0197 in.) in thickness, open at each end, forming a mould of 30 millimetres ($1\frac{3}{16}$ inches) internal diameter and 30 millimetres high. On either side of the split is attached an indicator with a pointed end, the distance from each of these ends to the centre of the cylinder being 165 millimetres ($6\frac{1}{2}$ inches).

In conducting the test, the mould is to be placed upon a small piece of glass and filled with cement gauged in the usual way, care being taken to keep the edges of the mould pressed gently together while this operation is being performed. The mould is then to be covered with another glass plate, a small weight is to be placed on this and the mould is then to be immediately placed in water, at a temperature of 58 to 64 degrees Fahrenheit, and left there for 24 hours.

The distance separating the indicator points is then to be measured, and the mould placed in cold water, which is to be brought to boiling point in 15 to 30 minutes and kept boiling for six hours. After cooling, the distance between the points is again to be measured; the difference between the two measurements represents the expansion of the cement, which must in no case exceed 12 millimetres after 24 hours' aeration, and 6 millimetres after 7 days' aeration.

Time of Setting.

Setting time for slow-setting cement shall not be less than two hours nor more than five hours.

Storage of Cement. Cement must be thoroughly aerated or seasoned before leaving the manufacturers.

It should be stored at the site in a dry shed, large enough to hold at least the maximum amount to be used in any two consecutive weeks. Each consignment should be kept separate. The shed should have a wooden floor with a clear open space beneath it for ventilation and to ensure the floor being kept perfectly dry.

Mixing Concrete. The concrete should be thoroughly mixed in small quantities in accurate proportions. It should be worked to a slightly wet consistency, preferably in a mechanical mixer, and laid as rapidly as possible. No concrete which has commenced to set should be used.

If materials are mixed by hand, the sand and cement should first be well mixed in a dry state. Water should then be added from a rose. The aggregate should then be added, having been previously damped, and should be thoroughly mixed with the mortar, until the colour of the cement is uniformly distributed throughout the whole mass.

The amount of water added should be such that the concrete can be easily puddled round the reinforcements and against the forms without appearance of excess of water. Sea water should not be used.

Laying Concrete. The concrete should be used as quickly as possible after mixing, in small quantities at a time. It should be spread in layers not more than 3 in. thick, especially near the reinforcements. It should be rammed or tamped vigorously till moisture begins to appear on the surface and all air bubbles and voids have been excluded, the object being to secure perfect contact between concrete and reinforcement, and thorough consolidation of the concrete.

Each section of concreting should, as far as possible, be done in one operation. The full thickness of floor slabs should always be laid at one time; when work is temporarily stopped the temporary end should be along the line of the span (*i.e.*, parallel to the longitudinal reinforcement).

When work is resumed upon any concrete that has set,, the working face should be roughened with a cutting tool, washed thoroughly clean, and covered with a layer of cement mortar ½ in. thick, composed of equal parts of cement and sand. The new concrete should then be rammed against the old as hard as is possible without injuring it.

Concreting should not be done when the temperature is less than 34 deg. F. When laid it should be protected from the action of frost, and in hot weather it should be shielded against the sun's rays and kept well wetted.

Particular care should be exercised to avoid disturbing the set of the placed concrete and, until sufficient time has elapsed for the setting to take place, no imposed load, such as that caused by walking over it, laying planks or other timbers upon it, or burdens, however light, should be allowed.

Testing Concrete. Test pieces of concrete should be prepared before and during the execution of the work. These should be in the form of 6 in. cubes made from the cement, sand, and aggregate to be used in the work, mixed in the proportions specified and consolidated in the same way. They should be tested in compression 28 days after moulding, and the average strength for concrete made with 4 of aggregate, 2 of sand, and 1 of cement should not be less than 1,600 lbs. per sq. inch. Cubes tested after four months should have a strength of 2,400 lbs. per sq. inch in compression.

Steel. Steel bars and rods for reinforcement should have an ultimate tensile strength of not less than 60,000 lbs. per sq. inch, and a yield point of not less than 32,000 lbs. per sq. inch. The elongation should not be less than 22 per cent. on a gauge length 8 times the diameter of the test piece. In bars over 1 in. diameter the gauge length may be four diameters and the elongation should then be not less than 27 per cent. Steel wire should have an ultimate strength not less than 80,000 lbs. per sq. inch, and a yield point of not less than 55,000 lbs. per sq. inch.

The metal should be clean and free from loose scale or loose rust. It should not be oiled, tarred, or painted.

Reinforcements should be placed and kept in the exact positions detailed in the drawings. The bars nearest to the surface of the concrete should be from 1 inch to $1\frac{1}{2}$ inches from such surface in beams and columns, and $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in floor slabs or similar thin structures.

Steel should be stored at the site in a clean dry place.

Centering. The moulds or forms to contain the concrete must be substantially and accurately constructed, plumb and true to line, well fixed, braced and supported to take the weights they are required to carry.

Well-seasoned red wood, pine or spruce is recommended.

For small columns, beams and joists, 2 in. timber is usually sufficient; for floor slabs, $1\frac{1}{4}$ in. timber on bearers 6 in. x $2\frac{1}{2}$ in., or $4\frac{1}{2}$ in. x 3 in. about 2 feet apart, with posts $4\frac{1}{2}$ in. x 3 in. or 6 in. x $2\frac{1}{2}$ in. having bracings $4\frac{1}{2}$ in. x $1\frac{1}{2}$ in.

For square columns three sides of the mould should be bolted or clamped together; the fourth side should be left open but braced at intervals, sufficient to keep it to shape. This open side should be gradually built up as the concrete is placed. For this purpose strong cross timbers, fixed with wedges behind vertical runners, should be used.

Other shaped columns should all be filled from an open side, to allow the steel to be kept in its proper position, the structure to be gradually built up, and the concrete efficiently consolidated. On no account should enclosed forms be used, as they necessitate filling in of the concrete from a considerable height, under which conditions the work cannot be properly inspected.

For beams and joists the bottom timbers should lie on wedges resting on the top of posts. The sides of the forms should then be bolted or clamped to these bottom timbers in such a manner that the whole of the timbers supporting the floor slabs and the sides of the beams can be removed without disturbing the bottom timbers or the posts. These last named should always remain up longer than the less important timbers. Bearers to carry the boards for the floor slabs may be fixed to the side of the beam boxes on wooden fillets.

Immediately before placing the concrete the forms should be carefully cleaned out, after having been trued up for changes due to atmospheric or other influences. A coating of soft soap, oil, or dead whitewash may be applied to facilitate removal of the forms.

The forms for beams should be laid with a camber equal to 1/200th of the span.

Striking of Centres. The time during which the centres should remain in position depends upon varying circumstances, such as dimensions of work, state of weather, etc. The casing of columns, sides of beams, and soffits of floor slabs, should remain up for at least 14 days. Soffits of beams and large span arches should remain up for at least 28 days. If frost occurs during setting, the time should be correspondingly increased.

General. All work should be in accordance with the recommendations published in the second Report (1911) of the Joint Committee on Reinforced Concrete.

Colouring of Concrete. Concrete may be coloured any required shade by the addition of colouring matter to the Cement. This should be thoroughly mixed with the dry cement before the latter is added to the aggregate.

To obtain a white cement, powdered chalk or barium sulphate should be added in the proportion of 1 to 2 of Portland Cement.

To obtain blue, green, yellow, red or black colours the proportion of colouring matter required is not so great. It consists of various oxides, of which in some cases as little as 1 part to 10 of Portland Cement is sufficient; it is seldom necessary to use a larger proportion than 1 part to 5.

POINTS FOR CONCRETE USERS.

The following is a brief summary of important points to be observed in connection with concrete for reinforced work:—

AGGREGATE.

Select the aggregate carefully, keep a sample of the selected aggregate and compare with it each consignment of material received at the site.

If possible, select an aggregate that does not require washing.

Do not use a dirty aggregate, or one of otherwise doubtful quality, because it happens to be easily obtainable.

Crush all aggregate to pass a $\frac{3}{4}$ in. mesh.

Screen out all material less than $\frac{1}{4}$ in. and measure it as sand.

Do not use sand which leaves a yellow or a black residue on the hand when examined, or shows the slightest trace of loam or peat.

CEMENT.

Use Portland Cement only, and preferably a well-known brand.

Use slow-setting cement.

Test thoroughly before using.

Test each consignment frequently for soundness and time of setting.

Store in a dry place.

Reject cement which has become caked through having been damp.

PROPORTIONING.

Measure the voids in aggregate and sand before deciding the proportions for concrete.

MIXING.

Mix the sand and cement well together dry (if mixing by hand).

Add water from a rose.

Do not use sea water.

Damp the aggregate, add it to the mixed sand and cement, and mix all together until the colour is uniform.

LAYING.

Lay quickly, in small quantities.

Give special attention to ramming.

See that the concrete is well rammed round all the rods and is thoroughly consolidated.

Do not let dirt from trenches get into the concrete.

See that reinforcements are not moved by ramming.

When joining on to work which has set, hack the surface and put on $\frac{1}{2}$ in. layer of cement and sand mortar.

Protect against frost and against hot sunshine.

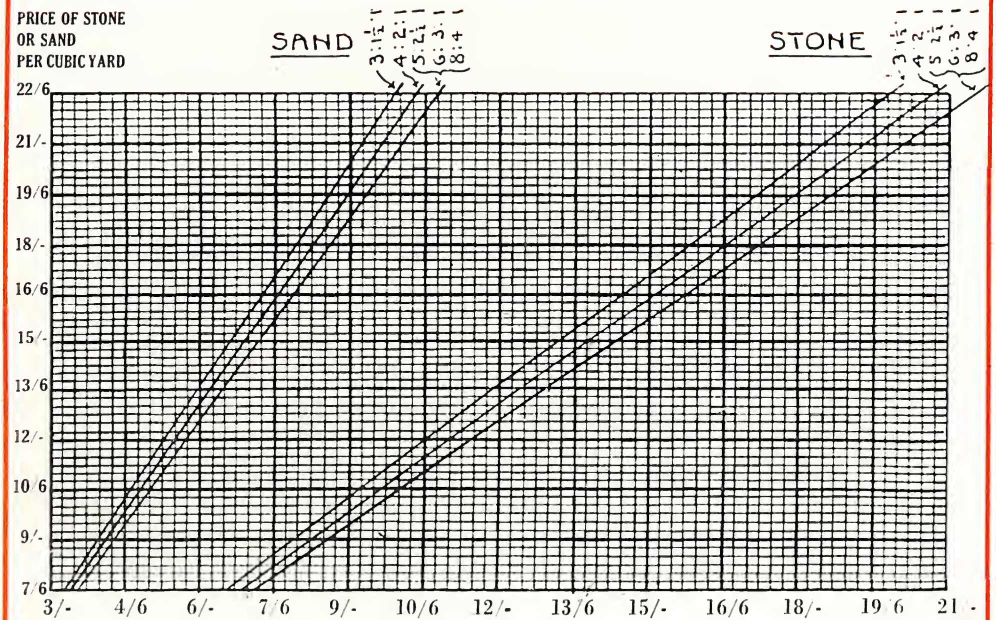
CENTERING.

See that centering is well braced and rigid.

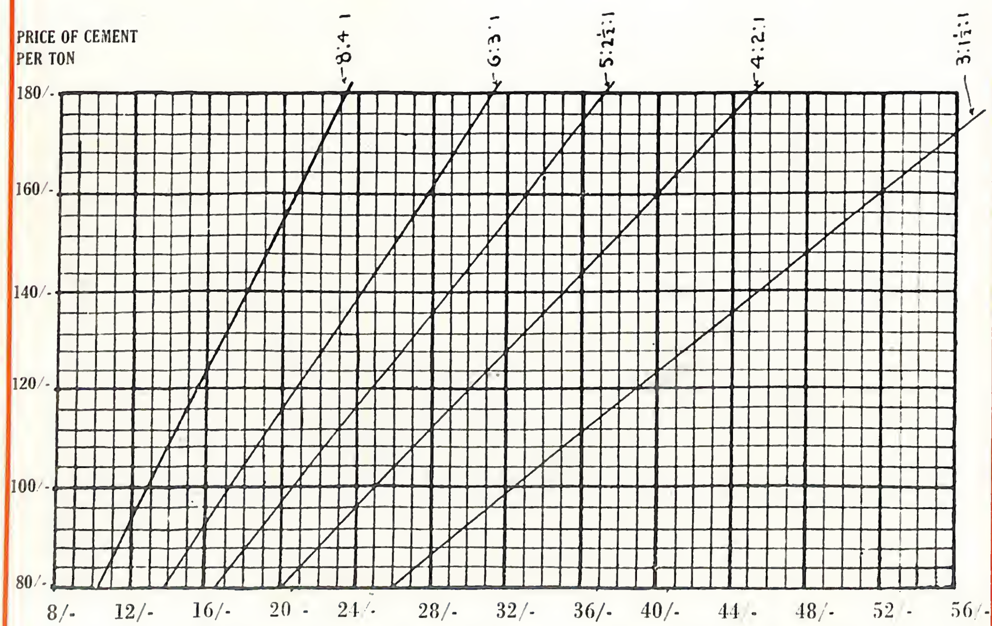
Allow camber for long span beams.

Damp the centering before laying concrete.

Do not remove until concrete is properly set.



COST OF STONE OR SAND PER CUBIC YARD OF CONCRETE.



COST OF CEMENT PER CUBIC YARD OF CONCRETE.

COST OF CONCRETE MATERIALS.

As the sand and cement used in the mixing of concrete mostly go to fill the voids in the stone, the volume of the concrete is less than, being only about two-thirds of, the combined volumes of the materials measured separately, dry, before mixing. The exact volume varies with the strength of the mixture. It requires about $1\frac{1}{2}$ cubic yards of dry materials, measured separately, to produce one cubic yard of concrete. The following Table gives the Quantities of Stone, Cement, and Sand required to make one Cubic Yard of Concrete, for mixtures of various strengths, assuming an average class of stone with 45 per cent. to 50 per cent. voids.

	$3:1\frac{1}{2}:1$ mixture cu. yds.	4 : 2 : 1 mixture cu. yds.	$5:2\frac{1}{2}:1$ mixture cu. yds.	6 : 3 : 1 mixture cu. yds.	8 : 4 : 1 mixture cu. yds.
Stone ...	.88	.92	.96	.96	.96
Sand ...	.44	.46	.48	.48	.48
Cement	.30 or 728 lbs.	.23 or 560 lbs.	.19 or 462 lbs.	.16 or 388 lbs	.12 or 292 lbs.

The cost of materials required for any mixture depends on the price of the several materials and the proportions of the mixture. The Diagrams opposite show at a glance the separate Costs of the Materials per Cubic Yard of Concrete for various prices and mixtures.

Example.—To find the cost of stone required per cubic yard of concrete, 4: 2: 1 mixture with stone at 15/- per cubic yard.

Find the point marked 15/- on the vertical line at left hand side of diagram; from this point follow the horizontal line until it intersects the diagonal line for stone marked 4: 2: 1;—from this point of intersection follow the vertical line down to the bottom horizontal line. The point thus reached on the bottom horizontal line is one division past the point marked 13/6, *i.e.*, it is 13/9, which is the required cost of stone per cubic yard of concrete.

MEMORANDA FOR CONCRETE USERS.

1 ton of Portland Cement . . . . equals 18 sacks of 125 lbs. nett

1 cu. ft. of Portland Cement, loosely filled . . . . equals 87 to 90 lbs.

1 cu. ft. of Portland Cement, tightly packed . . . . equals 110 lbs.

Average weight of 1:2:4 reinforced concrete . . . . equals 144 lbs. per cu. ft.

1 gallon of water . . . . equals .16 cu. ft. equals 10 lbs.

1 cu. foot of water . . . . equals $6\frac{1}{4}$ gallons equals 62.4 lbs.

Average quantity of water in the cu. yard of dry materials
equals from 18-24 gals.

1 ton of river sand	equals	21	cu. ft.
1 ton of pit sand	„	22	„
1 ton of ballast	„	22	„
1 ton of coarse gravel	„	23	„
1 ton of clean shingle	„	24	„
Capacity of wooden wheelbarrow . . equals 1-10th cu. yd.	equals	2.7	cu. ft.
Average load of broken stone for wooden wheelbarrow . .	„	2.4	„
Average load of sand for wooden wheelbarrow	„	2.5	„
Large load of broken stone for iron wheelbarrow	„	3.0	„
Large load of sand for iron wheelbarrow	„	3.5	„
Average load of concrete for iron wheelbarrow	„	1.9	„
Large load of concrete for iron wheelbarrow	„	2.2	„

Average time of man filling wheelbarrow with concrete . .
equals 1 1-3rd minutes

Quantity of concrete mixed, wheeled 50 feet, and rammed
equals 1 cu. yd. per man per $4\frac{1}{2}$ hours

Approximate percentage of strength of concrete at different ages, strength at 1 year being taken at 100:—

28 days	60
2 months	75
3 months	85
4 months	90
6 months	95

Approximate percentages of average crushing of basalt:—

	26 %	$2\frac{1}{2}$ in. metal
	19.5 %	2 in. ,,
	16.75 %	$1\frac{1}{2}$ in. ,,
	11.75 %	$1\frac{1}{8}$ in. ,,
	8 %	$\frac{3}{4}$ in. screenings
	8.75 %	$\frac{5}{8}$ in. ,,
	9.25 %	Toppings
Total	100 %	

SIX RULES.

1. Mix materials thoroughly.
2. Have concrete in final position within 20 minutes of first wetting.
3. Tamp well and spade the edges.
4. Protect the finished concrete from sun and rain.
5. Do not remove forms till concrete is hard.
6. When hand-mixing, use small batches.

TESTS RELATING TO B.R.C. REINFORCEMENTS

Slab No. 1.

Slab No. 2.

Slab No. 3.

Fig. 24.

FLOOR SLAB TESTS.

The accompanying photos show reinforced concrete floor slabs tested to destruction. Each slab is 3 ft. wide, 4¼ in. thick, and 11 ft. 9 in. between centres of supports.

The slabs are "freely supported," resting on the edges of steel angles laid in concrete blocks, a loose steel flat 3 in. wide being interposed between the angle edge and the slab to prevent the edge from cutting into the slab. The slabs were all made of similar concrete, on the same day, by the same workmen, and were all tested on the same day. They were made on the 4th August, 1916, and tested on the 19th October, 1916, being 10 weeks and 6 days old. The slabs were tested by loading with blocks of spelter weighing about 63 lbs. each.

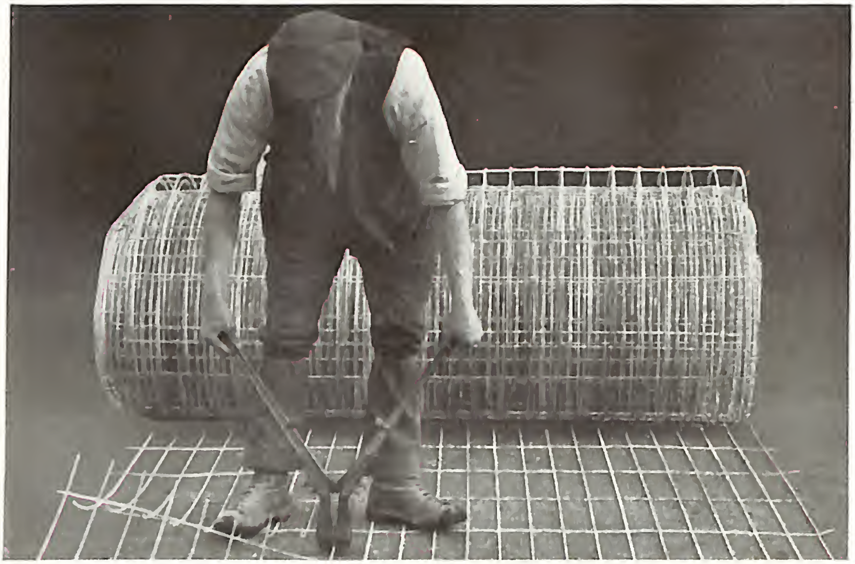
SLAB No. 1 is reinforced with seven mild steel rods (of 30 tons per sq. in. tensile strength), each $\frac{5}{16}$ in. diam., giving .180 sq. in. reinforcement per foot-width of slab. The centre of reinforcement is ¾ in. above bottom of slab. The slab weighs 1,836 lbs., and carried a superimposed load of 3,402 lbs. (total load 5,238 lbs.) before failure took place.

SLAB No. 2 is reinforced with B.R.C. Fabric, Ref. No. 10, consisting of No. 6 gauge longitudinal wires at 3 in. centres with No. 10 gauge cross wires at 12 in. centres, giving .116 sq. in. reinforcement per foot-width of slab. The centre of reinforcement is ¾ in. above bottom of slab. The slab weighs 1,836 lbs., and carried a superimposed load of 3,528 lbs. (total load 5,364 lbs.) before failure took place.

SLAB No. 3 is reinforced with B.R.C. Fabric, Ref. No. 8, consisting of No. 4 gauge, longitudinal wires at 3 in. centres, with No. 10 gauge cross wires at 12 in. centres, giving .169 sq. in. reinforcement per foot-width of slab. The centre of reinforcement is ¾ in. above bottom of slab. The slab weighs 1,836 lbs., and carried a superimposed load of 6,048 lbs. (total load 7,884 lbs.) before failure took place.

It will be noted that the slab reinforced with No. 10 Fabric, having reinforcement only two-thirds of that of the slab reinforced with steel rods, carried a slightly greater load, while the slab reinforced with No. 8 Fabric, having almost the same amount of reinforcement as the slab reinforced with steel rods, carried 50 per cent. greater total load, and 80 per cent. greater superimposed load.

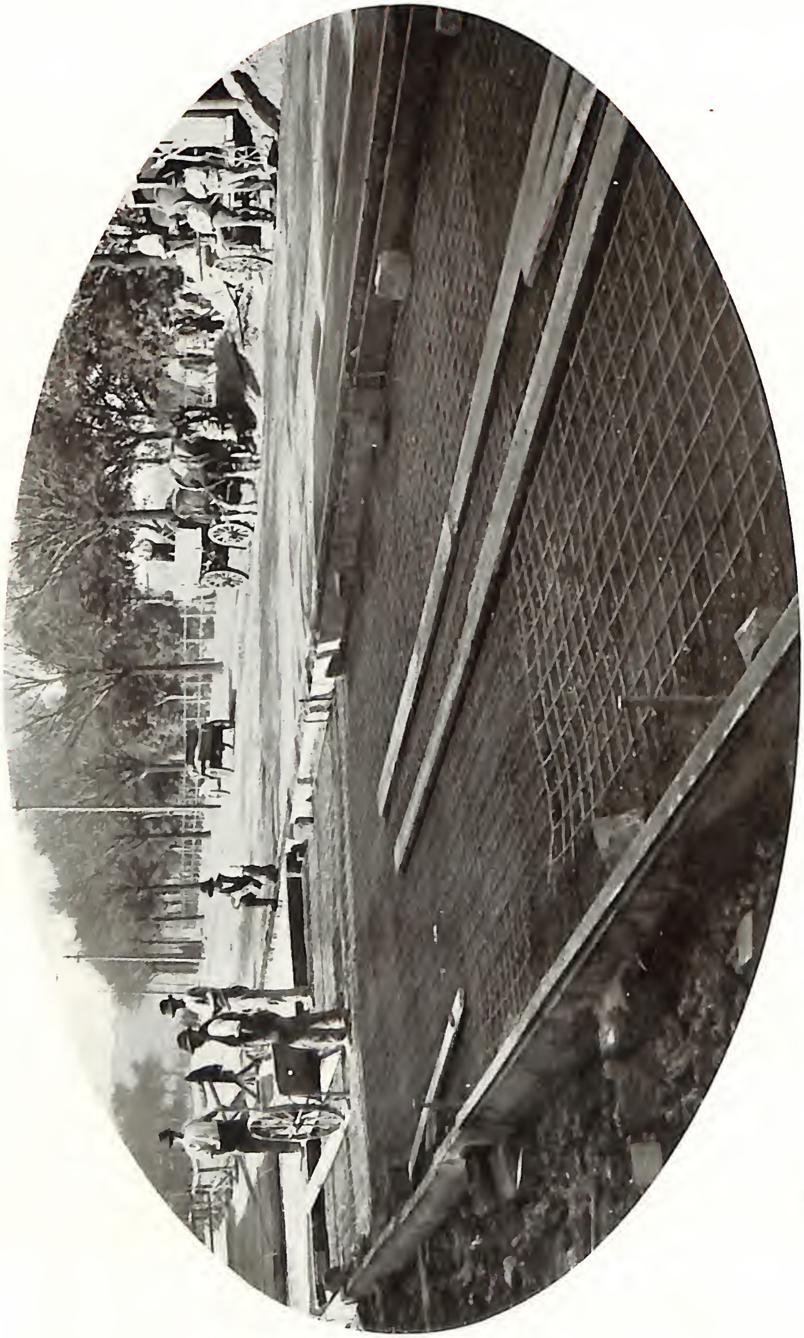
The slab reinforced with steel rods cracked at one place, and the crack continued to open out through local extension of the reinforcement, whereas the slabs reinforced with Fabric had a number of smaller and evenly distributed cracks.



CUTTING B.R.C. FABRIC AT SITE (FOR ROAD REINFORCEMENT).
Note how very simple it is.

Illustrations

Roads

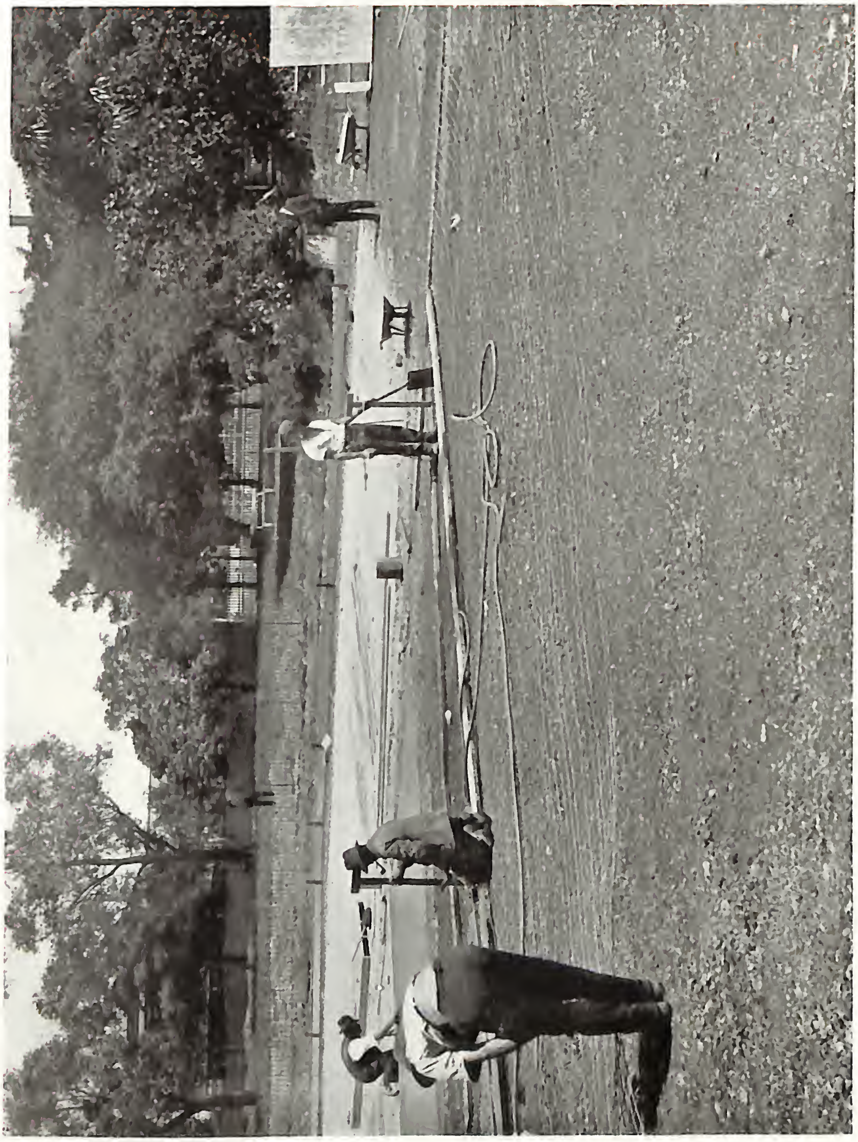


BATMAN AVENUE, MELBOURNE.

For Melbourne City Council Wood Blocks on Concrete Foundation, reinforced with B.R.C. Fabric.
City Engineer: H. E. Morton, Esq., M.I.C.E.

ELECTRIC TRAM TRACK, CHURCH STREET, RICHMOND.

For Melbourne and Metropolitan Tramways Board. Foundations reinforced with B.R.C. Fabric. Engineer: E. Strickland, Esq., M.I.E.A.



CHILDREN'S WADING POOL, EXHIBITION GARDENS, MELBOURNE.

For the Melbourne City Council. Bed reinforced with B.R.C. Fabric.
City Engineer: H. E. Morton, Esq., M.I.C.E.

BURWOOD ROAD, BURWOOD, SYDNEY.

For Burwood City Council. Complete Concrete Road, reinforced with B.R.C. Fabric.
City Engineer: Oswald I. Rogers, Esq.

CARBARITA ROAD, CONCORD, NEW SOUTH WALES.

For the Concord Council. Complete Concrete Road reinforced with B.R.C. Fabric.
City Engineer: Phillip Caro, Esq., M.B.E., B.E.

CANAL BED, LEICHARDT CANAL, LEICHARDT, SYDNEY.

For Sydney Harbor Trust. Reinforced with B.R.C. Fabric.
Engineer-in-Chief: W. E. Adams, Esq.

FALCON STREET, NORTH SYDNEY.

For the North Sydney Council. Complete Concrete Road reinforced with B.R.C. Fabric.
City Engineer: J. D. Dewar, Esq., B.E., A.M.I.E.

MILLER STREET, NORTH SYDNEY, NEW SOUTH WALES.

For North Sydney City Council. Complete Concrete Road, reinforced with B.R.C. Fabric.
City Engineer: J. D. Dewar, Esq., B.E., A.M.I.E.

SYDNEY ROAD. BRUNSWICK, VICTORIA.

Bitumen surface on concrete foundation, reinforced with B.R.C. Fabric.
Engineer: P. S. Robinson, Esq., C.E.

LYGON STREET, CARLTON.

For the Melbourne City Council.
Bitumen on Concrete Foundation, reinforced with B.R.C. Fabric.
City Engineer: H. E. Morton, Esq., M.I.C.E.

LANE COVE ROAD, NORTH SYDNEY.

For the North Sydney Council. Complete Concrete Road, reinforced with B.R.C. Fabric.
City Engineer: J. D. Dewar, Esq., B.E., A.M.I.E.

NORMANBY ROAD, CAULFIELD, MELBOURNE.

For the Caulfield City Council. Tar Macadam reinforced with B.R.C. Fabric.
City Engineer: W. J. M. Woolley, Esq., C.E.

RIGHT-OF-WAY, MALVERN, VICTORIA.

For the Malvern City Council. Reinforced with B.R.C. Fabric.
City Engineer: B. M. Coutie, Esq., M.C.E.

PEEL STREET, MELBOURNE.

For the Melbourne City Council. Wood Blocks on Concrete Foundation. Reinforced with B.R.C. Fabric.
City Engineer: H. E. Morton, Esq., M.I.C.E.

SWAN STREET, MELBOURNE.

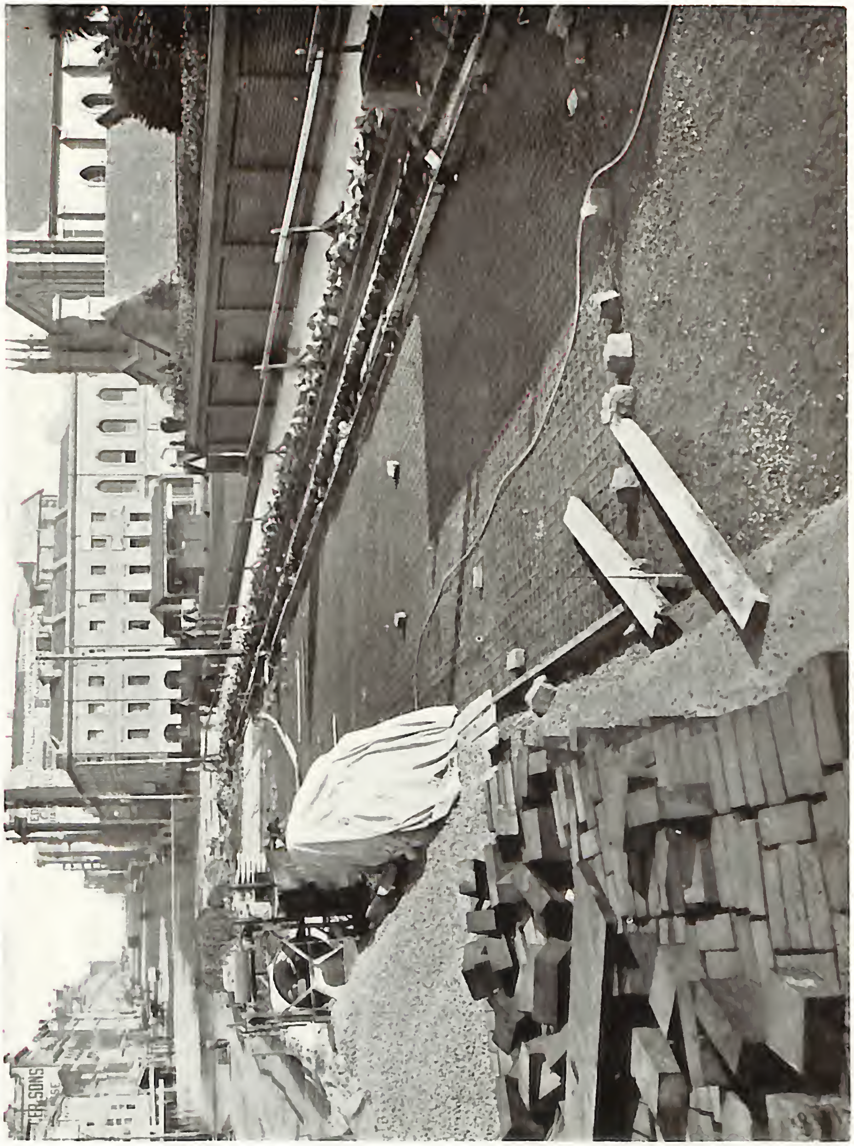
For the Melbourne City Council.
Wood Blocks on Concrete Foundation, reinforced with B.R.C. Fabric.
City Engineer: H. E. Morton, Esq., M.I.C.E.

BALLARAT STREET, YARRAVILLE, VICTORIA.

For the Footscray City Council. Wood Blocks on Concrete Foundation. Reinforced on a B.R.C. Fabric.
City Engineer: C. J. H. NEYLON, Esq., C.E.

HIGH STREET, NORTHCOTE, VICTORIA.

For the Northcote City Council. Tar Macadam reinforced with B.R.C. Fabric.
City Engineer: W. C. Howitt, Esq., C.E.



LONSDALE STREET, MELBOURNE.

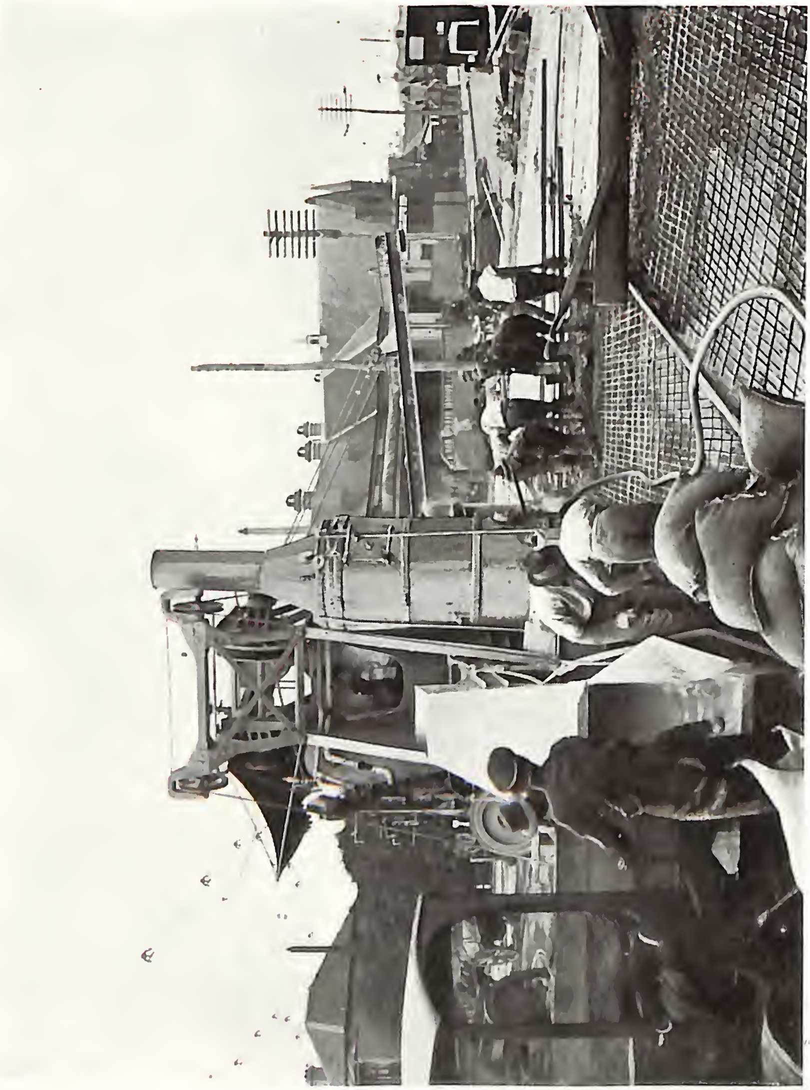
For the Melbourne City Council. Wood Blocks on Concrete Foundation. Reinforced with B.R.C. Fabric.
City Engineer: H. E. Morton, Esq., M.I.C.E.

MOTORDROME.

For Melbourne Carnivals Pty. Ltd. Track reinforced with B.R.C. Fabric.
Architect: Messrs. Blackett & Forster.

PRINCE'S HIGHWAY, OAKLEIGH, VICTORIA (AUSTRALIA).

Constructed by The Country Roads Board, Victoria.
Engineer-in-Chief: A. E. Callaway, Esq., C.E.
Complete Concrete Road reinforced with B.R.C. Fabric.



NEW CANTERBURY ROAD, DULWICH HILL, NEW SOUTH WALES.

Constructed for the Petersham Council. Engineer: E. Pearson, Esq. Contractors: Concrete Construction Ltd. Complete concrete road reinforced with B.R.C. Concrete.

Illustrations
Structures

BANKING OFFICES, COLLINS STREET, MELBOURNE, VICTORIA.

Constructed for the State Savings Bank of Victoria. Concrete and brick structure, concrete portion reinforced throughout with B.R.C. Reinforcements. Architects: Messrs. Peck and Kemter.

COMMERCIAL TRAVELLERS' CLUB BUILDING, MELBOURNE (AUSTRALIA).

Architects: Messrs. H. W. and P. B. Tompkins. All Floors reinforced with B.R.C. Fabric (9,000 square yards)

QUEEN VICTORIA HOSPITAL, MELBOURNE.

For Queen Victoria Hospital Committee. Floors reinforced with B.R.C. Fabric.
Architect: W. M. Shields, Esq., F.R.V.I.A.

GOVERNMENT INSURANCE OFFICES, BRISBANE.
Floors reinforced with B.R.C. Fabric. Government Architect: G. G. Hutton, Esq.

TAUBMANS BUILDINGS, MELBOURNE.

For Messrs. Taubmans Pty. Ltd. Reinforced entirely on B.R.C. System.
Architect: L. M. Perrott, Esq.

WAREHOUSE, MELBOURNE.

For the Forster Carpet Co. Pty. Ltd. B.R.C. reinforcements used throughout the new constructional work. Architects: Messrs. Gawler & Drummond.

BOURKE HOUSE.

Reinforced entirely on B.R.C. System.
Architect: Leslie M. Perrott, Esq.

PRINTING WAREHOUSE, MELBOURNE.

For Messrs. Brown, Prior & Co Pty. Ltd. Reinforced entirely on B.R.C. System.
Architects: Messrs. Gawler and Drummond.

"ADVERTISER" BUILDINGS, ADELAIDE.

For Messrs. J. L. Bonython & Co Floors reinforced with B.R.C. Fabric.
Architects: Messrs. Williams & Good.

VICTOR HORSLEY PROFESSIONAL CHAMBERS, COLLINS STREET, MELBOURNE, VICTORIA.

Reinforced throughout on the B.R.C. System.
Architects: Messrs. Blackett & Forster.

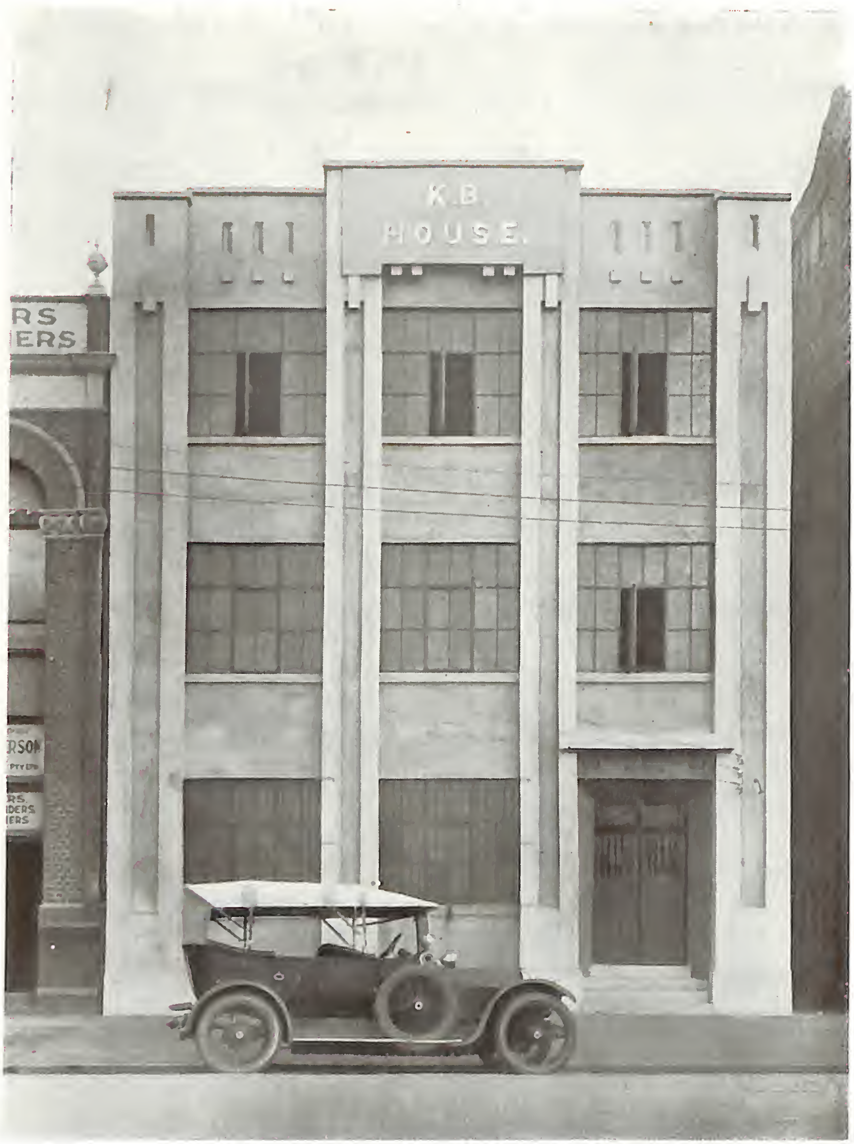
PEACOCK BUILDINGS, BOURKE STREET, MELBOURNE, VICTORIA.
Reinforced throughout on the B.R.C. System.
Architects: Messrs. Gawler & Drummond.

TEMPERANCE AND GENERAL LIFE SOCIETY BUILDING, BRISBANE, QUEENSLAND.
Reinforced entirely on the B.R.C. System. Architects: Messrs. Henderson, Alsop & Martin.

READ'S STORES, CHAPEL STREET, PRAHRAN, VICTORIA (AUSTRALIA).

Architects: Messrs. Sydney Smith and Ogg. All Floors reinforced with B.R.C. Fabric.

CONWAY BUILDINGS, CHAPEL STREET, PRAHRAN, VICTORIA.
Architect: F. W. Thomas, Esq. Floors reinforced with B.R.C. Fabric.

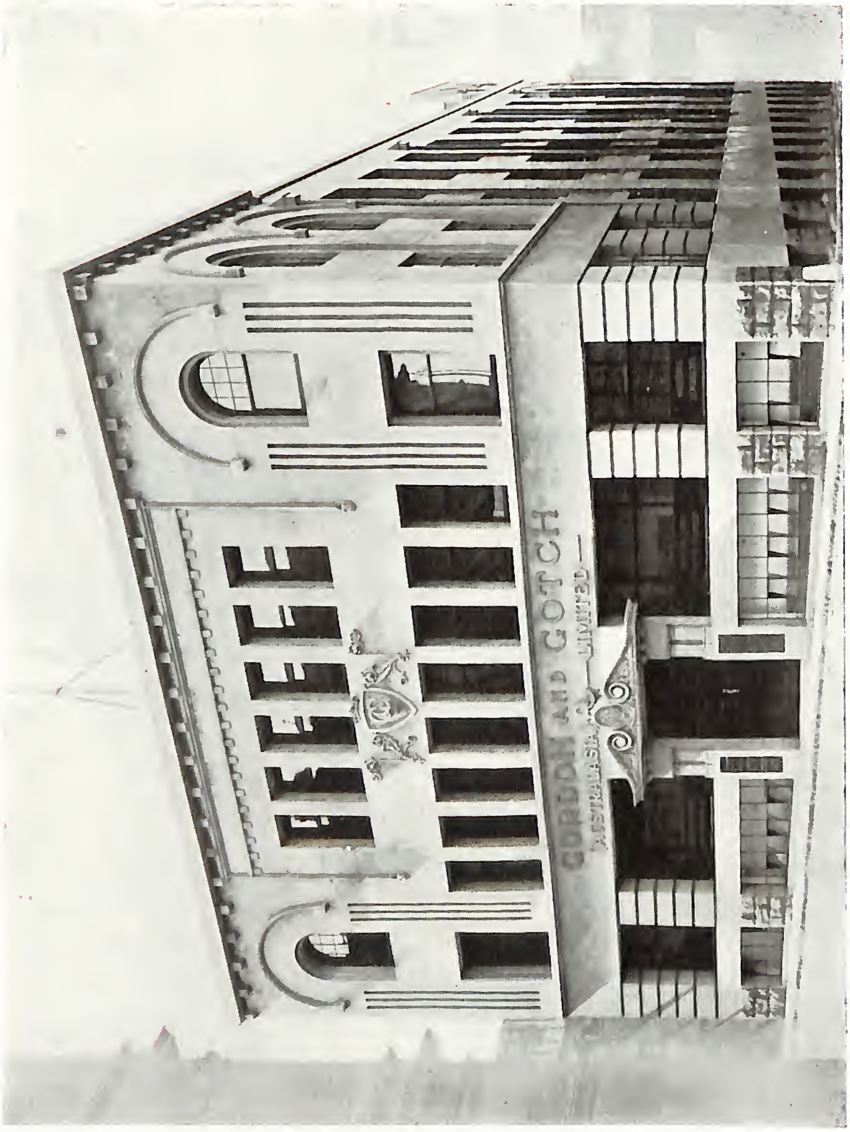


K.B. HOUSE, SOUTH MELBOURNE.

For Kosky Bros. Reinforced entirely on B.R.C. System.
Architect: G. J. Sutherland, Esq., A.R.V.I.A.

WOOLLEN MILLS, STAWELL, VICTORIA.

For the Stawell Woollen Mills Pty. Ltd. Floors reinforced with B.R.C. Fabric.
Architects: Messrs. T. Watts & Sons.



PRINTING WAREHOUSE, MELBOURNE.

For Messrs. Gordon & Gotch (Australasia) Ltd. Floors reinforced with B.R.C. Fabric.
Architect: W. M. Shields, Esq.

FACTORY, SOUTH MELBOURNE.

Brick faced concrete building reinforced entirely on B.R.C. System.
For Messrs. Busst & Bills Bros.
Architects: Messrs. Gibbs & Finlay.

WOOLLEN MILLS, LAUNCESTON.

For Messrs. Patons & Baldwins (Australia) Ltd. Floors reinforced with B.R.C. Fabric.
Architects: Messrs. North, Richard & Heyward.

THE ECONOMIC STORES LTD., PERTH, WESTERN AUSTRALIA.

Reinforced entirely on the B.R.C. system. Architects: Messrs. Hobbs, Smith & Forbes.

LASCELLES MEMORIAL LABORATORY, GEELONG.

For the City of Geelong, Victoria. Reinforced entirely on B.R.C. System.
Architects: Messrs. Laird & Buchan.

QUEEN'S COLLEGE, UNIVERSITY OF MELBOURNE, CARLTON, VICTORIA.
Reinforced entirely on B.R.C. System. Architects: Messrs. Eggleston & Oakley.

FACTORY, MELBOURNE.

For Messrs. Sturtevant & Bedford. Reinforced entirely on B.R.C. System.

SOFTGOODS RETAIL STORE, GEELONG, VICTORIA.

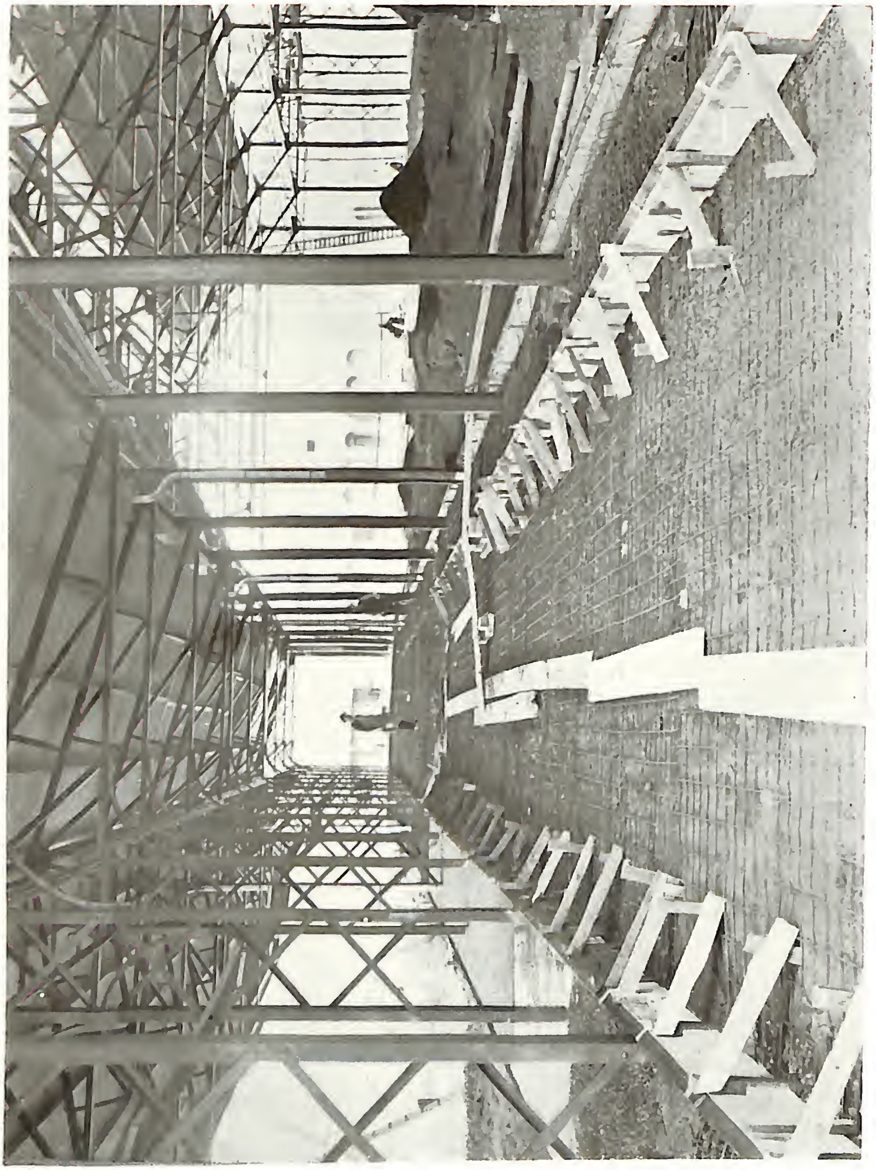
For Messrs. Bright & Hitchcocks Pty. Ltd. Reinforced entirely on B.R.C. System.
Architects: Messrs. Laird & Buchan.

FODDER STORE, GEELONG.

For Messrs. Harvey, Dann & Co. Reinforced entirely on B.R.C. System.
Architect: W. H. Cleverdon, Esq.

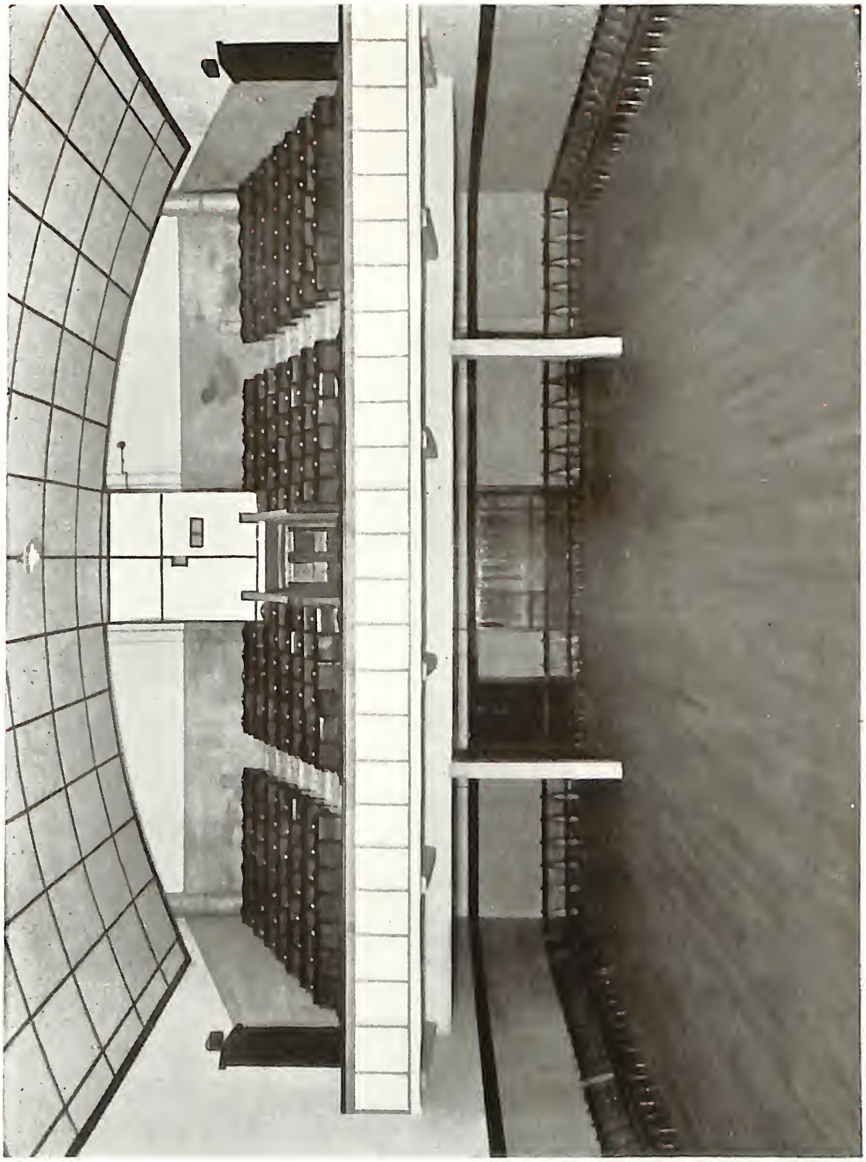
GRIMWADE FLATS, SOUTH YARRA, VICTORIA.

For Brigadier-General Grimwade. Reinforced entirely on B.R.C. System.
Architects: Messrs. W. & R. Butler.



VICTORIA MARKETS, MELBOURNE.

For the Melbourne City Council. Floors reinforced with B.R.C. Fabric.
City Engineer: H. E. Morton, Esq., M.I.C.E.

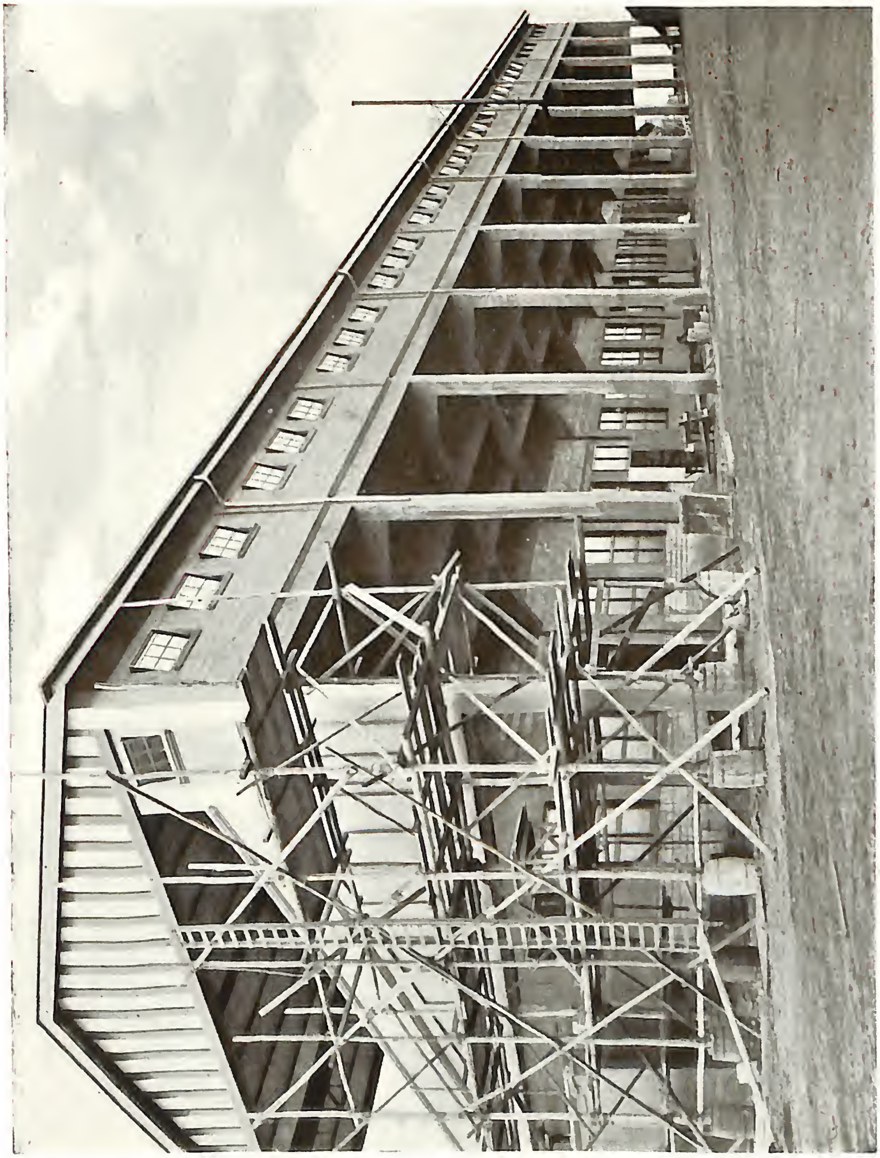


PICTURE THEATRE, WARRAGUL, VICTORIA.

For the Warragul Picture Theatre Company Ltd. Reinforced entirely on B.R.C. System.
Architects: Messrs. Blackett, Forster & Craig.

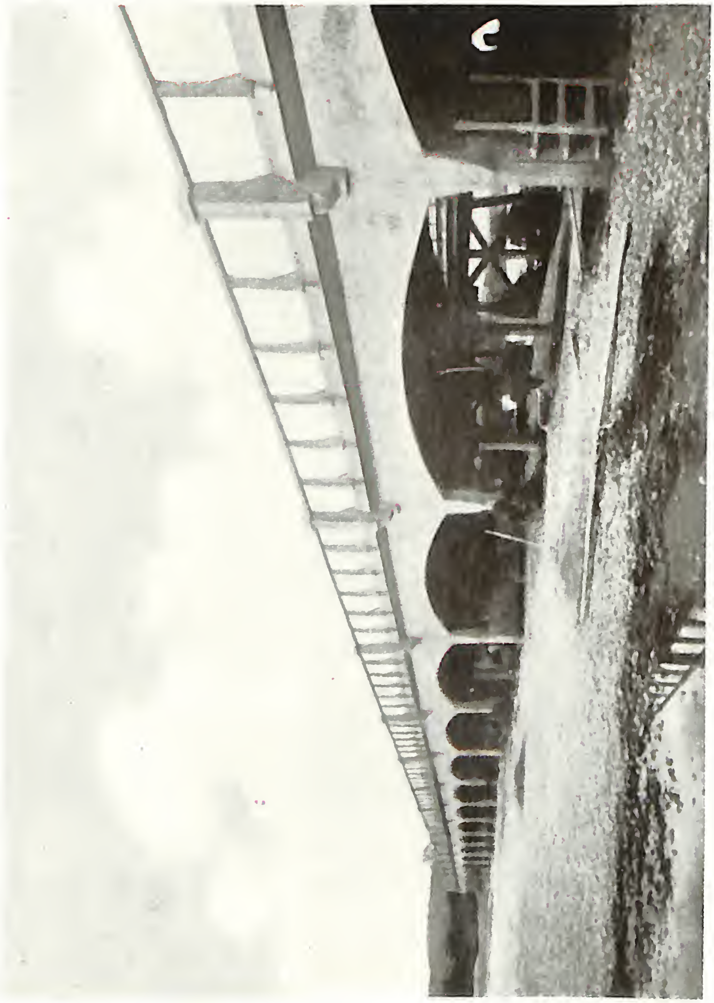
MOTOR SHOWROOMS, MELBOURNE.

For Messrs. Dalgety & Co. Ltd. Floors reinforced with B.R.C. Fabric.
Architects: Messrs. D'Ebro, Mackenzie & Meldrum.



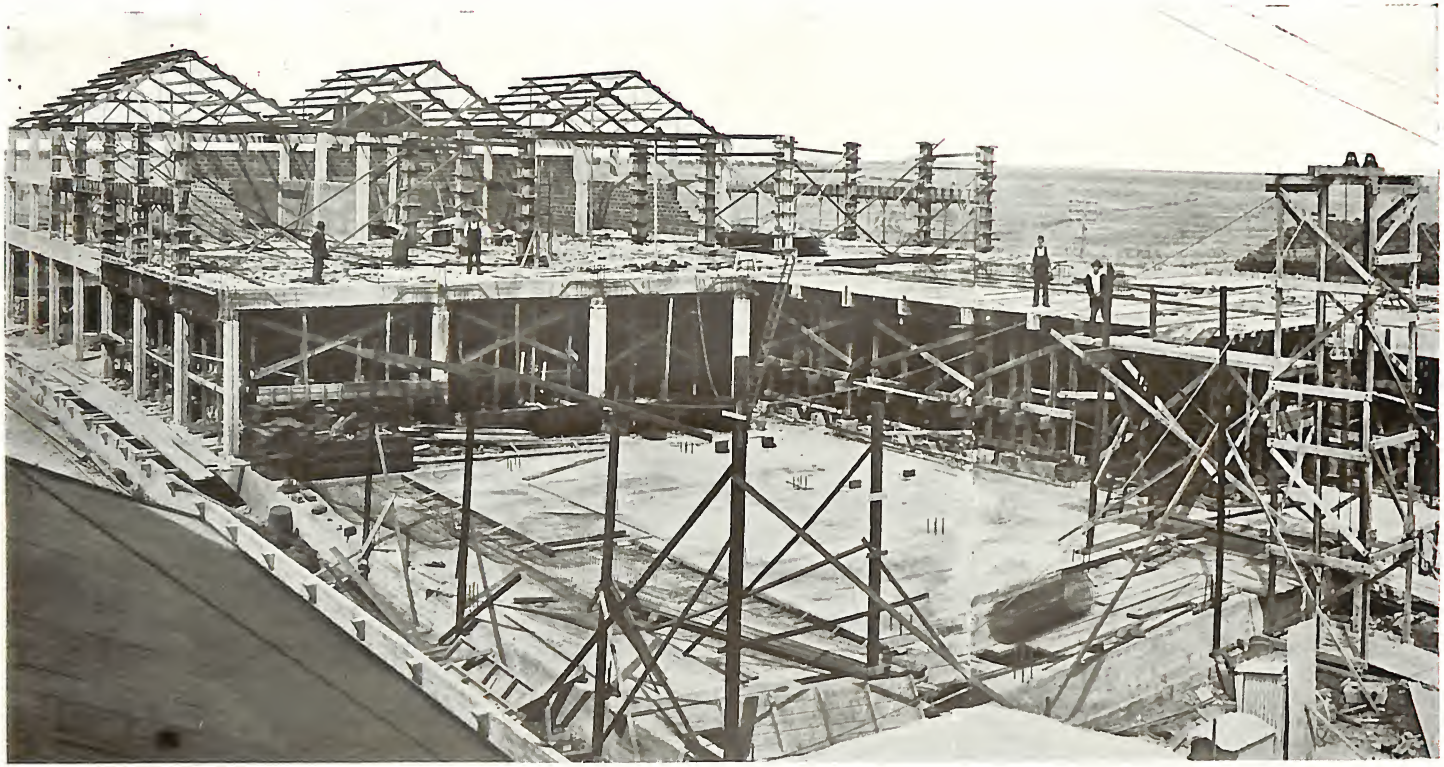
GRANDSTAND, SHOWGROUNDS, FLEMINGTON, VICTORIA.

For the Royal Agricultural Society of Victoria. Reinforced entirely on the B.R.C. System.
Architects: Messrs. PECK & KEMTER.



ASHLEY RIVER BRIDGE, NEW ZEALAND.

Engineer: F. W. Marchant, Esq., M.I.C.E. Reinforced entirely on B.R.C. System.



FREEZING WORKS FOR THE WIMMERA INLAND FREEZING CO. LTD., VICTORIA (AUSTRALIA).

B.R.C. Reinforcements throughout.

WIMMERA INLAND FREEZING WORKS, MURTOA, VICTORIA.

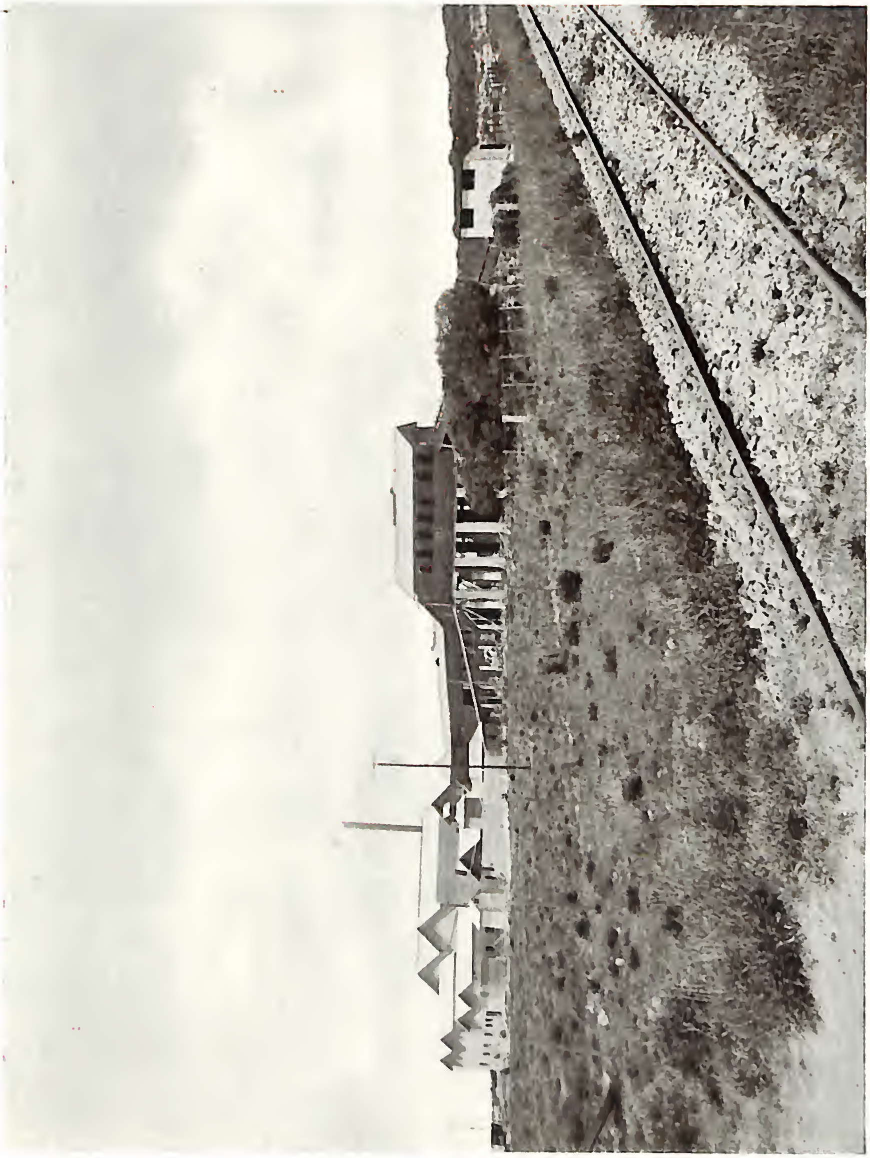
For Wimmera Inland Freezing Works. Reinforced entirely on B.R.C. System.
Constructional Engineers: Messrs. John S. Metcalf Co. Ltd.

W.A. MEAT EXPORT FREEZING WORKS AND ABATTOIRS,
FREMANTLE, WEST AUSTRALIA.

Architects: Messrs. D'Ebro, Mackenzie & Meldrum. Floors reinforced with B.R.C. Fabric.

NEWCASTLE ABATTOIRS.

Constructed for the Newcastle District Abattoirs Board, Newcastle, N.S.W.
Architects: Messrs. D'Ebro, Mackenzie & Meldrum. Floors reinforced with B.R.C. Fabric.



EYRES PENINSULA CO-OP. FREEZING WORKS AND ABATTOIRS, PORT LINCOLN, S.A.
Architects: Messrs. D'Ebro, Mackenzie and Meldrum. Floors reinforced with B.R.C. Fabric.

FLOUR MILLS, ALBION, VICTORIA.

For Messrs. John Darling & Son. Foundations, Lintols and Bricks reinforced with B.R.C. Reinforcements.
Engineers: Henry Simon Ltd.

JLH/DS. 26/3/27.

#14 - 21" wide 7d per lin. foot

TRENCH MESH

NO. 9 B. R. C.

(Refer to Page 28 in Handbook)

Widths of Fabric.					Price per ft. run
9"	...	...	...	...	3d.
x 12"	...	...	...	...	4d.
15"	...	...	...	...	5d.
18"	...	...	...	...	6d.
21"	...	...	...	...	7½d.
24"	...	...	...	...	9d.
28"	...	...	...	...	10d.

All prices less 10% nett 30 days F.O.R. Melbourne or delivered Site in 10 mile radius of Melbourne.

\- - - - - - -

Trench 3" wider than Fabric widths shown.

\- - - - - - -

SUBJECT TO CHANGE WITHOUT NOTICE.

JLL/GD. 7/3/1927.

LINTOL BEAMS.

Ref. No.	Price per ft. run.
L11	5d.
L12	4d.
L13	4d.
L14	6d.
L15	6d.
L16	7d.
L21	6d.
L22	8d.
L23	8d.
L24	10d.
L25	10d.
L26	12d.
L27	12d.
L28	16d.
L31	9d.
L32	12d.
L33	12d.
L34	15d.
L35	15d.
L36	16d.
L37	18d.
L38	27d.

All prices less 10% nett 30 days F.O.B. Melbourne or delivered on site within 10 mile radius of Melbourne.

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Small orders cartage extra outside City Area.

SUBJECT TO CHANGE WITHOUT NOTICE.

JLH/GD. 7/3/1927.

B.R.C. FABRIC.

(Refer to Page 28 in Handbook)

Ref. No.	Price per sq. yd.
1	8/- per sq. yd.
2	7/4d. per sq. yd.
3	6/1d. " " "
4	5/4d. " " "
5	4/8d. " " "
6	3/10d. " " "
7	3/3d. " " "
8	2/10d. " " "
9	2/1d. " " "
10	1/11d. " " "
11	1/10d. " " "
12	1/8d. " " "
13	1/7d. " " "
14	1/4d. " " "
610	1/6d. " " "
1210	1/- " " "
655	2/3d. " " "
636	2/6d. " " "
No. 4 Sp.	1/2d. " " "

All prices less 10% nett 30 days F.O.R. Melbourne or delivered site within 10 miles radius of Melbourne.

Small quantities cartage extra outside City Area.

For large quantities special quotes can be obtained at any time.

SUBJECT TO CHANGE WITHOUT NOTICE.